Huntington RUBBER COMPANY

Division of New Idria, Inc.

P.O.BOX 570·PORTLAND, OREGON 97207·(503) 246-5411·TELEX 36-0457

RUBBER GATE SEALS FOR HYDRAULIC STRUCTURES

CATALOG 105

FOREWORD

To aid the engineer, we have compiled engineering information, suggestions, and offer comments pertaining to the proper selection of seals.

The information contained in this manual is a result of many years of accumulated experience, aid, and advice of many prominent engineering firms and government agencies.

We offer this manual as a guide and believe it to be reliable. However, the results to be obtained cannot be guaranteed.

Huntington Rubber Company

ENGINEERING INFORMATION AND SPECIFICATIONS FOR HYDRAULIC GATE SEALS

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CHOOSING THE SEAL

Rubber seals are without doubt the most effective way to make gates, bulkheads, stop logs, valves, etc., water tight. The flexible property of the material adjusts itself to normal deviations that can be expected in the construction of hydraulic structures.

Normal irregularities resulting from welding stresses, from thermal expansion and contraction, and from deflection under load are to be expected. Lower construction costs result from the fact that with the use of rubber seals extremely tight tolerance requirements can be relaxed, which results in cost reduction without impairing the structure's effectiveness.

The following comments are made to acquaint the design engineer with a few fundamentals peculiar to the use and production of rubber seals.

With a large variety of sealing strips now available, the designer has a wide range of choice. Should he use solid bulb, all rubber seals, or fabric reinforced seals, or hollow bulb seals, or is it advisable or necessary to use metal clad seals, or perhaps some of the angle-shaped and other unusual configurations in place of J or music note seals? The choice should be so made as to obtain the most effective results consistent with economy.

First, it must be recognized that no one can make suggestions that can govern all circumstances and conditions. The particular problems and conditions of the project obviously do and must control. Our comments are therefore intended solely for the consideration of the engineer so that he may then intelligently make his selection and design with the full awareness of all pertinent facts in his possession.

GUIDE FOR DESIGNERS

Before choosing the "type of seal" the designer has to select the correct method of sealing.

To suit most hydraulic conditions, we may group the presently developed seals into two major categories--"low head" and "high head" seals.

LOW HEAD SEALS

Here, where conditions are favorable to using the water pressure to aid in sealing, J type, or music note seals, are most frequently employed. These are, in fact, the most common, though some other types have been developed to meet certain conditions within this category. Here are a few suggestions:

(a) Flat, vertical lift gates, bulkheads, stop logs. The seals, when mounted on the face of the gates, are simple in design and easy to install. Where possible, a single plane seal mounted to the face of the gate should be used as the most economical. However, when necessary, a transition across the width of the gate can be provided; but molds being costly, it is desirable to check for presently available corners before making the selection.

(b) Large miter lock gates are generally sealed along the bottom edge with a so-called "lamb chop" seal,(4" thick bulb x 8½" wide with a 1¼" stem--Huntington Mold No. 2990).

Small miter lock gates often use a modified J seal, having a sharp, or a slightly radiused, corner on the sealing edge of the bulb. (Huntington Molds Nos. 3492 and 3492-A.) Some have used an angle shaped bottom seal (Mold No. 3545). The vertical seals are usually J seals. Sometimes, at the miter contact, the J seals are mounted on each gate, so that the seal on one gate will contact the seal of the other, with a provision for ample and easy deflection of the stem.

Drawings of mold numbers mentioned above can be found in our general catalog, or will be supplied on request.

(c) Radial tainter (spillway) gates which may be subject to greater dimensional changes due to thermal expansion and contraction, should have a wider J seal to allow for greater deflection of the side seals. Angle-shaped seals are also used as side seals. A recent addition is an angle-shaped side seal with a clamping knob, so that they need not be drilled for bolt holes, thus allowing for easy seal adjustment after the gates are installed.

(d) Where debris may be present, a guard to prevent damage to the seal is often provided--especially on bottom seals.

HIGH HEAD GATES

For most high head installations, pressure actuated seals are used. The pressure source is usually the head pressure of the reservoir itself. On fixed-wheel gates, for instance, the seal, being set for bare contact, does not add to the friction load during gate movement because the pressures on both sides of the seal are equalized. As the pressure downstream of the gate drops, the seal, under the influence of the head pressure, moves toward the seal plate. Such seals are double-stem (center bulb) seals, and should be clamped only on the extreme edges of the seal. For a description of this seal's function, we refer the interested reader to paper No. 3000, entitled "Fixed Wheel Gates For Penstock Intakes", written by Sylvan J. Skinner, of the Bureau of Reclamation, published in the American Society of Civil Engineer Transactions.

We want to emphasize that the stems on these seals should be compressed only on the edge knobs by the

clamp bars, and not toward the center, or the bulb; thus the seal's ability to move toward the seal plate is not restricted.

Because it has been observed that an all-rubber seal has "extruded" into the space between the clamp bar and the seal plate, such seals have usually been brass-clad. Aside from preventing such extrusion. brass-clad seals also have a lower coefficient of friction than all-rubber seals. A serious off-setting disadvantage of metal-clad seals, however, is their rigidity, so that the usual benefit of rubber's flexibility is lost.

Of considerable promise is a more recent development. This is a layer of plastic bonded to the sealing surface of a rubber seal. This, while retaining the usual flexibility of a rubber seal, not only prevents the seal,(by its low friction coefficient of about 0.1), from being drawn into the space between the clamp bar and seal plate, but also often allows the use of lower capacity, thus less expensive, hoisting equipment. A more detailed decription will be found in the following pages.

A–MOLDED VERSUS EXTRUDED SEALS

Huntington recommends only molded seals for use in hydraulic structures.

The only possible supportable reason for the consideration of extruded seals is economy. The saving, if any, is so small as to be negligible. At the same time the cross sectional dimensions fluctuate so widely that their effectiveness is impaired and any cost advantage is lost. Even in short pieces fluctuations occur repeatedly within a sealing strip's length. These variations caused by the rotation of the extruder screw are often so great that the effect of preset is nullified, or in instances becomes excessive. Also, molded corners often necessary for effective sealing do not meet the cross section in complete and satisfactory alignment.

Extruded seals appear on the scene only occasionally and then usually by the failure of the specifications to specifically limit seals to "molded seals". The addition of this requirement is a safeguard that should always be included

B–FABRIC REINFORCED SEALS

At one time, years ago, fabric reinforcement was almost always specified. This has fallen into general disfavor and is now rarely specified, as it has been found that fabric adds nothing to the life of the seal and in fact, such seals are generally less durable than all rubber.

Fabric is occasionally still called for, usually as a carry-over from past practices, or from a misinterpretation of the word "reinforcement" as applied to fabric. This description, which would be correct where it implies reinforcement in the sense that it "stiffens" the stem of the seal,is incorrect if used in the sense that it"strengthens" the seal.

Unless a stiffer stem, which is substantially more resistant to bending is needed, fabric reinforcement should not be specified. Fabric merely adds substantially to the cost of the seals, and has the disadvantage of shorter life and possibly higher friction loads.

C–SOLID OR HOLLOW BULB SEALS

1. Comparison of Effectiveness
   Some engineers specify hollow bulb seals for low head use, presuming them to seal more effectively at low heads because of the greater surface contact, or "nip" area. To the contrary, others feel that the pressure "per square inch" is higher in solid bulb seals by reason of less contact area and is therefore a more effective seal than a hollow bulb.

2. Contact Area: Contact Bond
   Proponents of the solid over the hollow seal hold that the compression, or contact, bond of rubber to the seal plate resulting from prolonged gate closure is greater by reason of the larger surface contact area of hollow seals, and that, therefore, solid bulb seals, requiring less starting force, are desirable.

3. Elastic Memory
   Also, compression of a hollow seal over prolonged periods of time will result in less recovery to the original shape when the pressure is removed. The compression or distortion of a solid bulb seal, especially at low heads is so little as to be negligible.

4. Comparative Costs
   Contrary to belief, hollow bulb seals are usually more costly than solid despite the use of less material.

5. Plugs for Hollow Seals
   At splices or joints of seals, soft rubber plugs are used in the hole. These are cemented into place. Their purpose has often been misunderstood.
   The purpose of these plugs is:
   (a) to enable the fabricator of the gates to make perfect cuts in trimming the seals to length and
   (b) to present a full face of the seal ends for cementing or vulcanizing.

Plugs should never be considered or used as "dowels". They do not in any sense increase the strength of either vulcanized or cemented splices; and because perfect hole placement in both ends of joining seals is impossible to attain, such single plugs, if extending into the ends of both seals can only serve to misalign the seal ends to whatever extent the holes are off-center. Plugs, therefore, are inserted before final trimming of the seal and are cut off flush with the seal in the process.

D–METAL CLAD SEALS

1. Purpose
   Metal clad seals, (brass or stainless steel), are used for two principal purposes:
   (a) To reduce the friction load required to submerge or lift the gate.

(b) To prevent the seal from "extruding" or being jammed into the clearance space available between the clamp bar and the seal plate from the venturi action of the water when the gate is being closed under an unbalanced head.

(c) They do not, as some have believed, prolong the life of the seal. A metal surface is not nearly so resistant to abrasion as rubber. Consider, for instance, the universal use of rubber tires, not metal, for automotive vehicles.

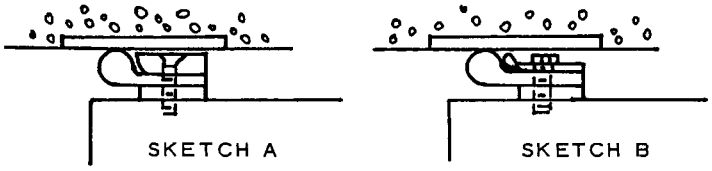
2. Advantages of Metal-Clad Seals

(a) Coefficient of Friction

We have found that most designers have been using a coefficient of 0.65 for metal seals. There is much disagreement concerning this subject. For instance, some use a factor as low as 0.30. Since there are many variables possible in the gates from project to project we do not propose to suggest the proper factor to use but are inclined to think in terms of about 0.35 or 0.45.

(b) Extruding under Pressure

The metal on the sealing or contact face of the seal will eliminate the tendency of the seal to enter the gap between the seal plate and the clamp bar. Some designers prefer to use an all-rubber seal and accomplish a similar result by reducing the size of the gap. This is done by using a thicker clamp bar, or a shaped clamp bar as shown below in sketches A & B.



3. Disadvantages of Metal Clad Seals.

(a) Cost

The least of the objectionable features is the comparatively high cost of such seals. Depending upon the seal configuration and design details involved, metal clad seals will cost from 3 to 5 times the cost of all-rubber seals.

(b) Rigidity

The principal objection is the fact that a metal clad seal is so rigid that some of the most apparent advantages of the rubber portion, such as its flexibility and its resistance to wear, are lost.

In the construction of any gate, especially large gates, some degree of misalignment resulting from the fabrication and welding processes during their construction is inevitable. To offset, close tolerance requirements add substantially to gate costs. If the gate itself is masterfully made and the fabricator has achieved a high degree of accuracy, it is still possible that imbedded parts in the dam structure itself, the seal plates or sill plates, may have efficiency disturbing variations.

Some designers have for this reason resorted to using only a quadrant of metal as shown in Figure 1, Mold No. 2329. In this instance the edge of the metal is placed exactly in the center of the sealing face so that the metal edge bears against the seal face; the quadrant of cladding in this instance is downstream to prevent the seal from being drawn in by the flow of the water.

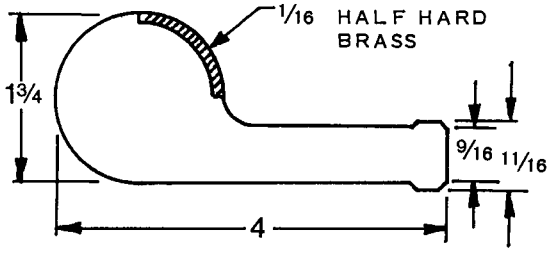


FIG. 1 NO. 2329

Others have resorted to slotting the center of the metal--see Fig. 2, or the edges as shown in Fig. 3. Of these, the slotting of the edges is preferred because no season cracking along the center line will occur during use.

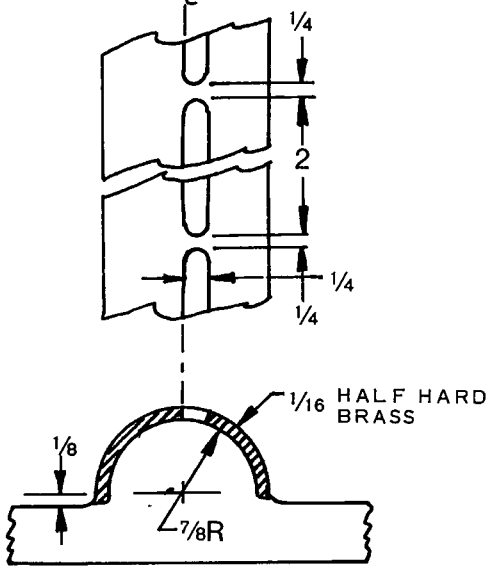
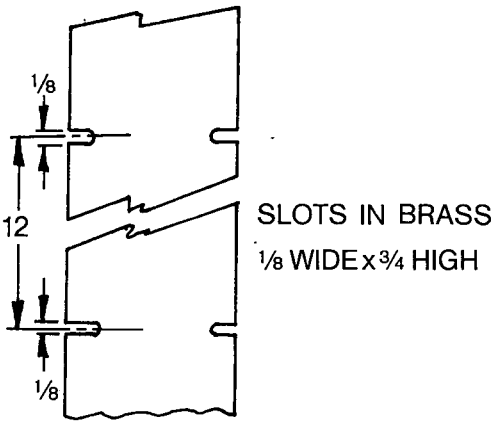


FIG. 2 TYPICAL CENTER SLOTTING



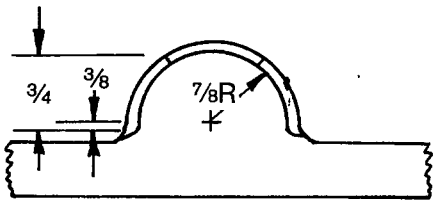


FIG. 3 TYPICAL EDGE SLOTTING

4. Maximum Lengths of Metal-Clad Seals.

Rubber seals and other continuous lengths of molded rubber products, such as conveyor belts, are stepped through the mold in the press as each "cure" is completed. Such a step occurs at intervals of 6 to 8 feet along the seal's length, depending upon the size or bulk of the cross section.

In the past most seal manufacturers have avoided producing metal-clad seals in lengths longer than the mold lengths. The main reason for this is because a weakness in the rubber-to-metal bond strength could be expected at each step cure.

We have developed a technique that now eliminates this problem, so that longer lengths can be made.

However, because long seals are difficult to handle on and off the gate during fitting, shipping or final attachment, with the danger of bending or "kinking" the metal and also because of the higher per foot cost in longer lengths, it is desirable to hold such lengths to a minimum. The maximum length, in any event, should be about 30 feet.

Most design engineers, especially those with long experience in the design and use of metal-clad seals, agree that such seals can be successfully employed in maximum mold lengths of 9 feet 6" if their specification requirements make clear that the gate fabricator must fit such seals snugly. This requires that the ends be square cut, (never beveled), and tightly fitted.

Usually such joints have been found to be satisfactory even without the use of any rubber cement. Some, however, require that rubber cement be employed as a "calking" compound to guard against leakage. However, cement should never be applied except upon final attachment of the seals to the gate in the field. This is to assure that 1) a good fitting dry joint has indeed been accomplished and 2) since the bond strength resulting from a cemented joint is not sufficient to assure against separation while handling the seal on and off the gate, cement would only become contaminated in the process.

5. Splices in Metal-Clad Seals

Though, as mentioned above, it has been well established by experience, occasionally a few engineers still have been unwilling to accept the theory that butted joints are indeed sound, and have gone to extremes in devising some form of mechanical jointing procedures. These are not only extremely costly, but of doubtful value.

If such an opinion prevails, by far the best procedure is to arrange that the lengths be field vulcanized together as the seals are finally being attached to the gates. This can be done by using special electrically heated splicing molds which are available on a rental basis, complete with splicing materials and instructions for their use.

In such splicing of metal-clad seals, bevel cut ends should not be employed. They must be square cut (at right angles). Such a joint may be expected to have perhaps a slightly lower tensile strength at the joint, possibly 35% of the tensile strength of the original material. However, such joints will be ample and adequate for the purpose (See Section H-2, "Fabricated Corners").

6. Specifications for Metal-Clad Seals

(a) Rubber
For rubber specifications refer to "Typical Rubber Specifications", Section F-1.

(b) Metal
See "Typical Metal Specifications", Section F-2.

E–HUNTINGTON ABRASION RESISTANT FLUOROCARBON FILM #4508

1. Description and Advantages

This product, in use by Huntington Rubber Company for over 20 years, is a plastic film securely vulcanized and bonded to the sealing surface of the rubber seal which reduces the seal's friction load to an extremely low level.

Since it is introduced into the mold along with the raw unvulcanized rubber compound, it is formed, molded and vulcanized simultaneously with the rubber, so

that the film is "inserted" or "recessed" into the rubber. Thus, its outer surface is flush with the surface of the rubber seal. A strong vulcanized bond between the fluoro-carbon film and the rubber results during this molding process.

Its particular significance is that it has the following advantages:

(a) Very low friction value.
(b) The same flexibility of all-rubber seals for conformance of the seal to the gate and to the seal plate despite fluctuations in plane of either or both.
(c) A substantial reduction in per-foot cost compared to metal-clad seals.
(d) The resultant low friction load allows a reduction in hoist capacities and the consequent savings in project costs. It also enables gate structures to submerge readily under unbalanced heads without any, or at least substantially less, artificial weighting, ballasting or loading to assure positive closure of the gate.

2. Maximum Lengths

For production in standard equipment, convenience in handling and lower cost, seal lengths should be limited to 9 feet 6". Although thoroughly as flexible as rubber for all functional purposes of the finished seal, the film has a very low elastic memory. Therefore, if a seal length is sharply bent in handling, the film cover may be stretched beyond its elastic limit and damaged beyond use.

If mandatory, longer lengths can be made by vulcanized splicing to a maximum of 40 feet. At such splice points the fluoro-carbon film will be interrupted by a gap of 1/8" to 1/4". This gap, however, is filled with rubber to the same plane or surface as the film. Thus no leakage, when in use, is induced. In the interest of economy the distance between such splices should be left to our discretion; especially, since such short rubber-filled gaps add only an insignificant amount to the total friction load.

Details for field splicing these seals will be furnished upon request.

The film thicknesses available for normal seals such as J seals or double stem seals as No. 2284, Fig. 4, etc., are .030" and .060". Thicker films can be supplied, but are practical only if the cross section of the sealing face is straight and not curved as on the seals above mentioned.

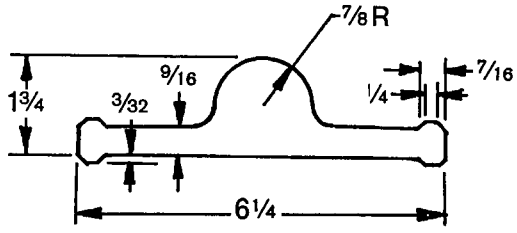


FIG. 4 NO. 2284

3. Specifications for Fluoro-Carbon Clad Film #4508

See Section F-3.

F-SPECIFICATIONS

1. Typical Rubber Specifications for Gate Seals

The rubber seals shall be molded only and the material shall be compounded of natural rubber or a copolymer of butadiene and styrene, or a blend of both and shall contain reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents and plasticizers. Physical characteristics shall meet the following:

Physical Test	Test Value	Test Method Specification
Tensile strength	3000 psi (min.)	Fed. Std.-- 601, Method 4111 or - ASTM D412
Elongation at break	450% (min.)	Fed. Std. - 601, Method 4121 or - ASTM D412
300% Modulus	900 psi (min.)	Fed. Std. - 601, Method 4131 or - ASTM D412
Durometer Hardness Shore Type A	60 to 70	Fed. Std. - 601, Method 3021 or - ASTM D676
Water Absorption	5% by weight (max.)	Fed. Std. - 601, Method 6631 or - ASTM D471
Compression Set	30% (max.)	Fed. Std. - 601, Method 3311 or - ASTM D395
Tensile Strength after Oxygen Bomb Aging	80% (min.) of tensile strength	Fed. Std. - 601, Method 7111 or - ASTM D572

Both natural rubber and butadiene and styrene, or a blend of both will meet or exceed these requirements. When neoprene is specified the tensile strength must be changed to 2,750 psi minimum.

It should be noted that a change in one characteristic will often affect one or more of the others. For example, a softer rubber will obviously have a lower modulus. Any such changes should be approached with caution and an inquiry should be directed to us before such revisions are made.

Design engineers often specify the specific polymer, such as "Natural Rubber", for example. When this limitation is imposed, the manufacturer has no alternative but to quote thus; though at the time of quoting the crude rubber price, being subject to market fluctuations due to world political conditions, may perhaps have reached a very high position.

The physical characteristics are clearly established by the specifications as identical, whatever the polymer may be. This assures a high grade material in any case. By permitting the above specifications to stand, and allowing the manufacturer the alternative, he will, logically, quote the lower cost material whichever it may be at the time.

It is our opinion that no reduction in quality will result from this practice, and yet a substantial reduction in cost may be accomplished.

2. Typical Metal Specifications

(a) Rubber for Metal-Clad Seals See Section F-1

(b) Metal Specifications
Metal, if brass, should be 1/16" thick half-hard brass; if stainless steel, should be 1/16" S.S. #304. Sometimes .040" metal is used. Thicker metal should be avoided, because it adds even more to the rigidity of the seal.

(c) Rubber to Metal Bond
The following is a typical specification for rubber to metal bond strength.

A test for adhesion bond for the chafing strip on the rubber-brass seals shall be conducted in accordance with ASTM Designation: D 413-39, machine method, procedure for strip specimens, with the results showing an average adhesion bond of 100 pounds per inch width for a separation at 1 inch per minute; or, the specimens may be tested by a strip test method where the rubber is stripped from the brass at a rate of 2 inches per minute (on a 1-inch wide specimen) by a minimum 40-pound load applied at an angle of 90° to the brass. In either method of test, the stripping shall show tear of the rubber and not failure of the adhesion bond between the rubber and the brass. Failure of any test specimen to meet the requirements of the test method used will be cause for rejection of the piece from which the test specimen was taken.

3. Fluoro-Carbon Film Specifications

The rubber itself will be in compliance with "Typical Rubber Specifications", Section F-1.

The fluoro-carbon film specifications should read as follows:

A fluoro-carbon sheath shall be bonded to the rubber on the sealing surface of the bulb. The sheath shall be Huntington Rubber Mills' abrasion resistant Fluoro-Carbon Film No. 4508 or equal. The outside surface of the fluoro-carbon sheath shall be free of adhering or bonded rubber. The fluoro-carbon shall have the following physical properties:

Tensile strength ..... 2,000 psi (min.)
Elongation ..... 250 per cent (min.)

Seal strips and corner seals shall be molded in lengths suitable for obtaining the finished lengths shown on the drawing and with sufficient excess length to provide test specimens for testing the adequacy of the adhesion bond between the rubber and the fluoro-carbon on the bulb. (Refer to paragraph E-2.)

At one end of each strip or corner seal to be tested, the fluoro-carbon shall be masked so as to prevent a bond for a distance sufficient to hold the fluoro-carbon securely during the test.

A 1-inch long piece of seal shall be cut from the end of the seal which has been masked or prepared.

The fluoro-carbon shall then be subjected to tension at an angle approximately 90° to the rubber surface, either by machine method at a rate of 2 inches per minute or by the deadweight method.

There shall be no separation between the fluoro-carbon and the rubber when subjected to the following loads:

	Machine method at 2 inches per minute	Deadweight method
.030 inch fluoro-carbon film	30 pounds-per-inch width	30 pounds-per-inch width
.060 inch fluoro-carbon film	30 pounds-per-inch width	30 pounds-per-inch width

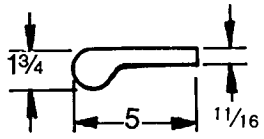
The test for adhesion bond shall be conducted in accordance with ASTM Designation: D413-39, using either the machine method or the deadweight method. Failure of any specimen to meet the requirements of the test used will be cause for rejection of the piece from which the test specimen was taken.

Except where tolerances are specified on the drawings, dimensions are nominal and slight variations will be acceptable. Molds shall be furnished by and will remain the property of the contractor.

G–SELECTING THE SEAL STRIP

Consistant with other factors that may influence the engineer's choice, a worthwhile consideration is the availability of the particular corner pieces required.

By checking the availability of corners from existing molds, before deciding which cross section to use, high mold costs can be avoided. For example, let us assume that transition corners as from our molds Nos. 3087 and 3088 (Fig. 5), are required. These seals have an 11/16" thick stem. This cross section will be equally as effective as a 9/16" stem, also common in this size of J seal. Therefore, by selecting the seal strip with the 11/16" stem, there will be a substantial cost saving which would be otherwise incurred in making new molds.



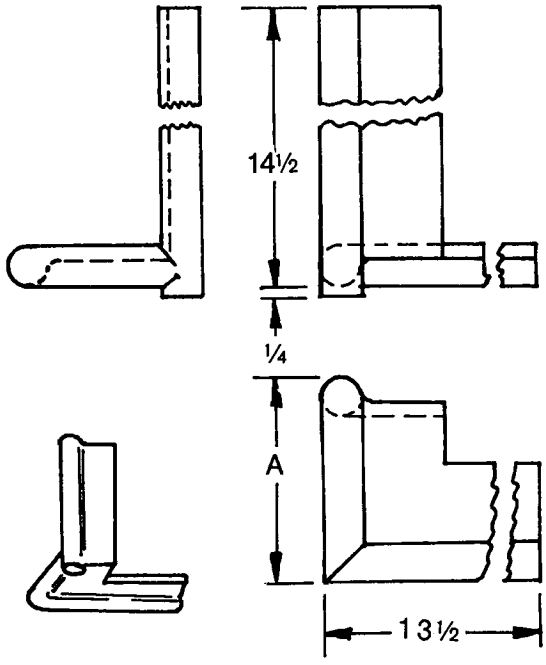


FIG. 5 NOS. 3087 – 3088

(DIM. A = 7^1_8, 7^3_4, 8^1_8, 8^3_{16}, 8^3_8)

Or, let us assume that circumstances require the use of an angle shaped bottom seal and a vertical J seal and that a leak proof joint between the two seals was needed. Such a corner is available in mold Nos. 4349 and 4350, Fig. 6. Since this mold is for a 2" diameter bulb J seal with a 1" thick stem, it would be wise to select this size, even though a 1¾" bulb would otherwise suffice.

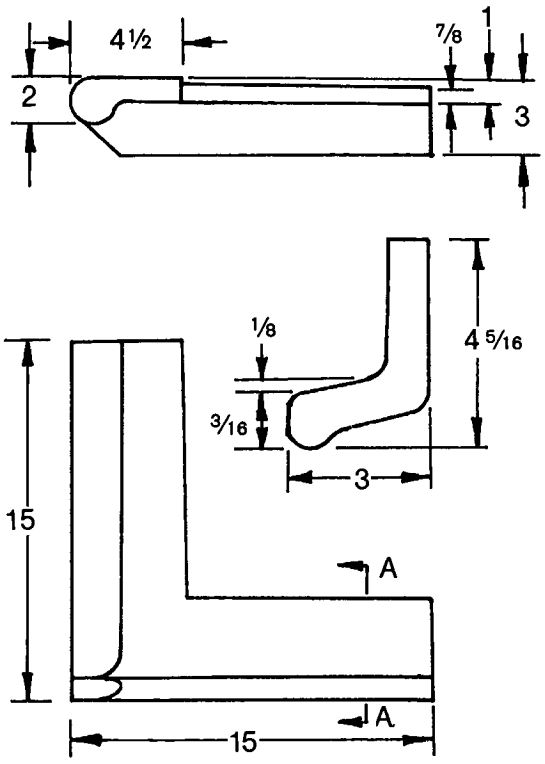


FIG. 6 NOS. 4349 – 4350

We say, therefore, first check the availability of existing corners, for which molds are always high in cost, before deciding upon the cross section to use.

H–SEAL CORNERS

The significance of available corners and how this may influence the choice of the seal strip has already been pointed out under Section "G" -- "Selecting the Seal Strip". There are, however, two types of corners which may be employed.

1. Full Molded Corners

Unless otherwise identified, all corners listed in the following pages are full-molded. This means that the raw rubber compound is charged into a steel mold, then vulcanized under high pressure and heat at one time into the final shape and size as shown on the drawings.

Wherever it is possible, both the best and lowest cost selection that can be made is to choose the seal that can employ such existing tooling.

If a quantity of gates is involved, or if it is planned that the same corners will be used for other succeeding projects or structures, then it is still desirable to use full-molded corners. Though such corner molds are comparatively expensive, their cost, when amortized over the larger quantity, is well worth it where perhaps severe conditions are involved. After all, they represent the best and strongest type of corner that can be made.

2. Fabricated Corners

Whenever a full-molded corner is available it should be used in preference to any other. Therefore, that is the first or preferred choice.

A second choice, is "Fabricated Corners". You will notice a number of molds so identified. This means that previously made full-molded corners are vulcanized spliced to strip, as are corners No. 4344 and 4345, Fig. 7, or strip to strip corner No. 4407, Fig. 8.

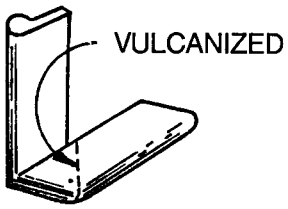


FIG. 7
FABRICATED CORNER
NOS. 4344 – 4345

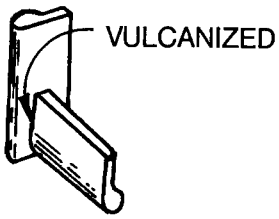


FIG. 8
FABRICATED CORNER
NO. 4407

When full-molded corner molds are available, the molding or production of actual corners--being molded at one time and thus requiring no hand fitting and splicing--is less costly than with fabricated corners. However, when such full-molded corner molds are not available and when the service and operating conditions permit, fabricated corners should be considered because the cost of molds therefore is substantially lower.

Normal vulcanized splices, such as described in Section I-1, being made with a 45° bevel cut resulting in more complete clamping pressure during splicing, are capable of tensile strength at the splice of 50% of the original tensile strength of the material. This is not true of the splices, though also vulcanized, in fabricated corners.

Since it may not be possible to make such splices with a bevel cut and though held securely and in proper alignment by the molds, the same joint strength cannot be assured. Thus, though we usually accomplish, as revealed by destructive tests, strengths of about 35% or more, we feel it advisable to guarantee only a minimum of 35% of the original strength of the material.

I– SPLICES

Though splices have been referred to under the various preceding sections, a summary and some further comments seem desirable.

Splice positions that cannot be accomplished at all, or which demand the construction of new and costly tooling are sometimes called-out on drawings. By observing the following suggestions these difficulties can be avoided.

It is generally the design engineer's intention to avoid having the splice line pass through a bolt hole. As a result, in his effort to avoid this occurring, he often selects the splice line position exactly midway between bolt holes, thus limiting the fabricator of seals to fixed positions which his tooling may not allow.

1. Vulcanized Factory Splices

Such splices are made in vulcanizing presses under ideal conditions. The seals are firmly held and clamped during vulcanization in special splicing molds.

A common difficulty results from the drawing specifying the angle of the bevel to be from left to right (or vice versa), when a bevel in the opposite direction would better fit the tooling conditions. In such cases, considerable time is frequently lost in correspondence to secure permission to reverse the angle, etc.

Corner molds listed in our catalog indicate the maximum length of the corner pieces such tooling will produce. In making a 45° bevel cut, an allowance for the loss of approximately ½" of length + ½ the web thickness should be made.

Also, it is desirable, in order to secure the best possible splices, that a minimum of 6" of "free" and "straight" strip be available beyond the limits of the splice line in both directions. Thus a firmer "grip" in the splicing mold is maintained during the splice cure. For this reason a splice should not be positioned so close to the other leg of a corner that this cannot be accomplished.

For your guidance, then, we would list the following suggestions:

1. All splices in all-rubber seals should be, wherever practical, on a 45° bevel as related to the "thickness" (not the "width"), of the seal. (This does not apply to metal or plastic clad seals.)
2. It is desirable that the center line of the splice be located in relation to the "web portion" of the seal's cross section, since the bolt hole is drilled only in the web. Therefore, do not limit the splice position needlessly by "fixing" it beyond this requirement.
3. The following notation on your drawing will result in satisfactory splices and yet give adequate leeway to the seal manufacturer--(This applies only to all-rubber seals)

   "Splice to be on a 45° bevel related to "thickness" of the seal. Direction of angle optional. Splice line must avoid bolt holes in web portion."

   Then show location of the bolt holes and leave the selection of the exact position of the splice or the direction of the angle to the fabricator.

2. Vulcanized Field Splices

This description has been construed to mean not only actual field splices at the site, but also performed at

points other than the rubber manufacturer's plant, such as at the steel fabricator's plant.

(a) Available Splicing Molds
Electrically heated splicing molds for a few of the more popular sizes are available on a rental basis. Complete instructions are provided, as well as the necessary materials for making the splices.

(b) Preparation
All-rubber seals should be bevel cut and spliced in accordance with the instructions on the preceding page.

(c) Metal-Clad Seal Splices
Metal-clad seals should not be bevel cut. (See also Section D-5, page 7.

Such splices are made without attempting to weld or otherwise make the metal also continuous, since this would destroy the rubber to metal bond. The joint will result in a gap of 1/8" to 1/4" between the metal ends and this joint will be completely filled with rubber. In fact, the mold will provide an "overlay" of rubber, the shrinkages will take place in this overlay and it is then ground off flush or slightly above the metal's outer surface "after the assembled seal is mounted into place on the gate"

(d) Avoiding Abuses
Some people have been under the impression that a splice made in metal-clad seals may be tested by bending the seal sharply at the splice (the 1/8" or 1/4" rubber filled gap between the ends of the metal). This is not a proper test of the adequacy of the splice and under no circumstances should this be done. The stresses are exaggerated, being centralized and concentrated only at this gap--and the force, while certainly insufficient to break the rubber-to-rubber bond and thus proving nothing--will tend to break the rubber loose from the metal along the terminal edges, if, indeed, the cladding is not also irretrievably bent out of shape.

3. Other Field Splices

(a) Butt Fitted Splices
Field splices, *if not vulcanized, should never be* made on a bevel. Pieces should be cut at a 90° (right) angle so that when they are butted tightly, one to the other, they will not "climb".

If so mounted and tightly butted, a water-tight joint is accomplished.

(b) Cemented Splices
Some designers will specify that a "cemented splice", "a cold cemented splice" or a "cold vulcanized splice" be made. To avoid confusion, these may all be called "cemented splices" and mean the same thing.

When such a "splice" is called out, it should be understood that, while a good cement will result in some bond strength, no splice or bond strength should be stipulated. The best of such splices is, in our opinion, inadequate to permit the removal of the seal from the gate for shipment or for the handling incident to re-attachment to the gate.

The principal value of a cement in such cases is as a "calking compound" to assure water tightness and not as a bonding agent.

We suggest, therefore, that the designer word his requirements about as follows:

"Seals shall be fitted by the fabricator to the gate in his shop by butting them tightly, one to the other. The ends of all pieces must be cut at right angles, not bevelled, to allow a tight butt fit. Seals should be cut, and/or dressed, slightly longer than required to permit such fitting without buckling or misalignment. No cement shall be used during such fitting."

By so stipulating, the designer will be assured of good and careful fitting, since no cement is present to obscure the joint, or hide an ill-fitting joint. Many seals have been so fitted and have given completely satisfying results. Should the designer wish to also require the addition of cement, as an added precaution against leakage, he may add the following sentence to the above suggested paragraph:

"Only during the final attachment of the seals to the gate should rubber cement be applied to assure water-tightness."

4. Summary - (Splices)

1. Vulcanized splices (cured in a mold) for all-rubber seals only, wherever practical, should be on a 45° bevel as related to the thickness (not the "width") of the seal.

2. Unvulcanized splices for all-rubber seals and all splices, including vulcanized splices for seals clad with metal or other materials shall be cut off square with respect to both height and width to avoid misalignment, which has a tendency to occur with beveled joints. These butted, square-cut joints may be cemented, or may be butted tightly without being cemented.

J-COEFFICIENT OF FRICTION

On this topic there is a great divergence of opinion. We can only report here the opinions of many in the industry, expressed to us during our numerous contacts together with our comments which are made in good faith and with

the best intentions, but without the guarantee of the results to be obtained. Each installation encompasses a a number of variables and should be individually analyzed.

1. Rubber Seals - Rubber to Metal Seal Plate
We find a range here of 0.65 to 1.5. This is admittedly a wide range. However, the majority use a coefficent of 1.0. Some test results we have seen report that they have been unable to substantiate a coefficient of more than 0.65 when tested wet.

   Because rubber has a peculiar tendency to contact bond when kept under tight compression for a period of time, we would suggest using, especially where this condition may exist, a factor of 1.0.

2. Metal-Clad Seals - Brass Cladding to Metal Seal Plates
Variously calculated at 0.30 to 0.65. We believe 0.35 to 0.45 to be a good range. Since the seal plates now used are usually made of corrosion resistant steel, some designers do not believe in also using stainless steel cladding on the rubber seal itself. For this reason brass-cladding is far more commonly used than stainless steel.

3. Huntington Abrasion Resistant Fluoro-Carbon Film No. 4508
This material has a coefficient of friction of 0.1. Because it is so much lower than either rubber or metal cladding, some designers have indicated that they are using 0.15 to 0.2 as an added safety factor. However, since this material has no evident tendency to compression or contact-bond, as do rubber seals, no allowance for this situation appears to be necessary.

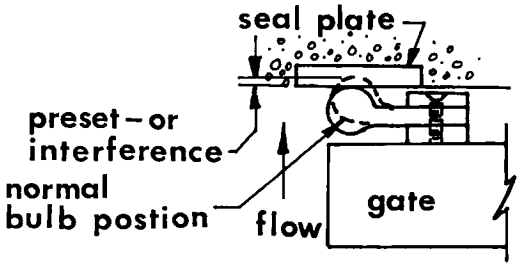
K-PRESET

Preset, the extent to which the stem should be placed under deflection, or as the case may be, the bulb under compression, should be held to the minimum necessary to accomplish a seal.

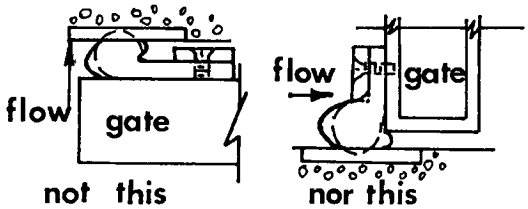
To keep friction load to a minimum, a preset of 1/4" or less is advisable. If all factors could be perfectly controlled, then a set to contact (no preset at all) would be adequate.

L-SUGGESTED MOUNTING OF SEAL

Wherever possible J seals should be mounted to utilize stem deflection thus:



Wherever possible the following should be avoided:



The reason is obvious if you examine the charts on pages 14 & 15. It takes a great deal of force to "compress" a seal bulb and comparatively little to "deflect" the stem of the seal. Furthermore, the degree of deflection can be controlled by varying dimension A, (page 15), thus reducing friction load to a minimum.

A further advantage of using deflection rather than compression is less need for close tolerance in gate dimensions and expansion or contraction in large gates, gate deflection under loads, etc. There will be a better recovery of the seal, after prolonged closure, to its original position than is possible when the bulb has been severely compressed.

This is not possible in all instances, but where there is a choice, it should be made in favor of stem deflection rather than bulb compression.

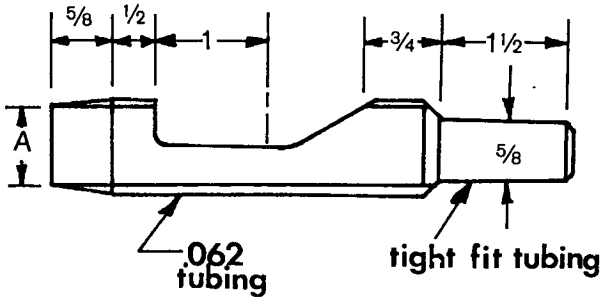
M-BOLT HOLES

Rubber gate seals are always supplied without bolt holes unless arrangements to the contrary are made.

It is less costly and a better fit can be assured if the seals are fitted to the gates, the holes marked, usually, by means of the clamp bars and the holes then drilled.

Drilling is done with a hollow-core drill bit--preferably used in a 1/2" power drill. The work should be kept wet while drilling to reduce the friction of the rubber to the drill bit and to prevent seizure.

The sketch below will suggest a suitable design of the drill bit.



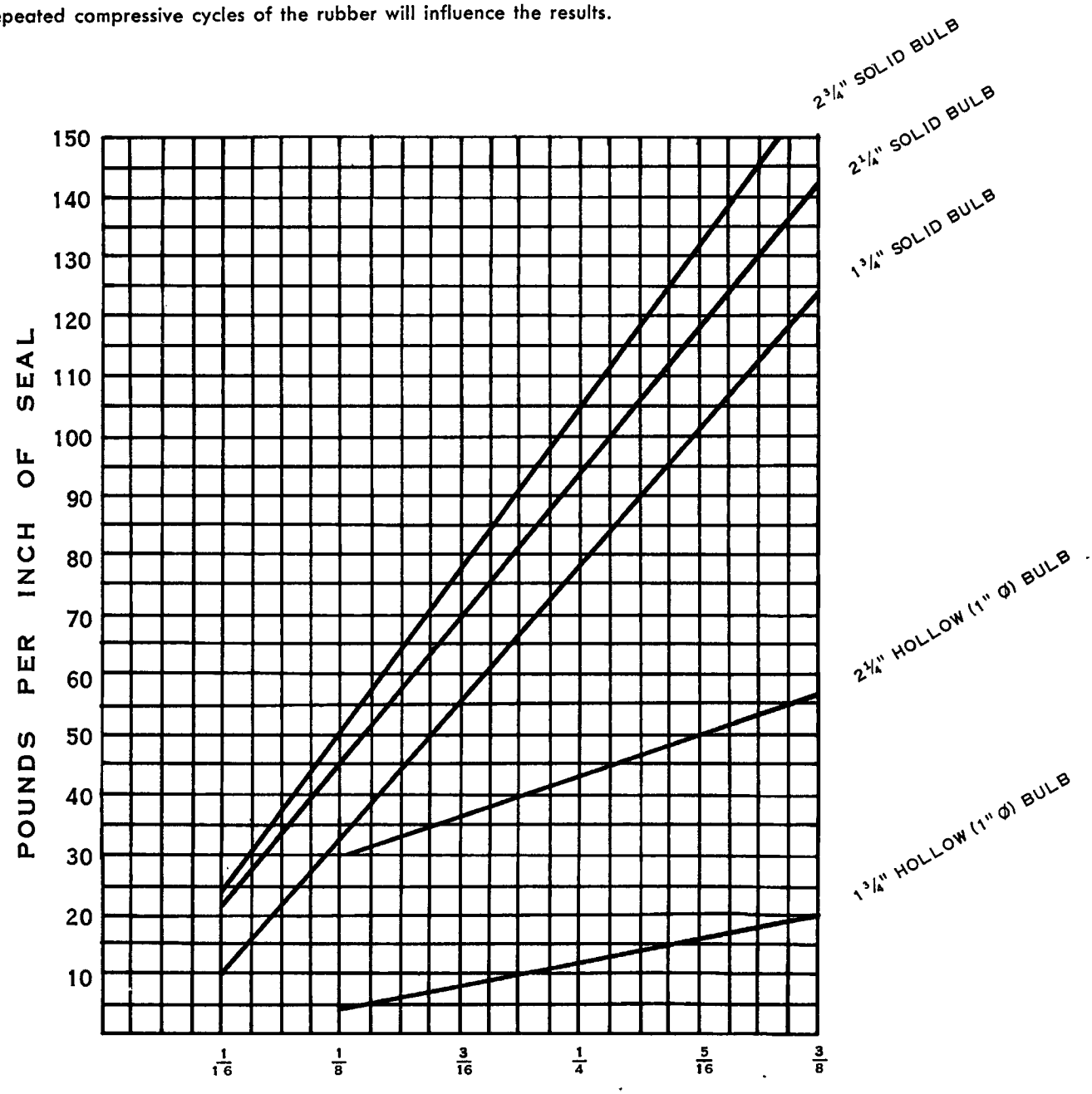
DIM. A = DIA. OF HOLE REQUIRED

THE INFORMATION CONTAINED HEREIN IS BASED UPON TESTS BELIEVED TO BE RELIABLE. HOWEVER, WE DO NOT GUARANTEE THE RESULTS TO BE OBTAINED.

COMPRESSION

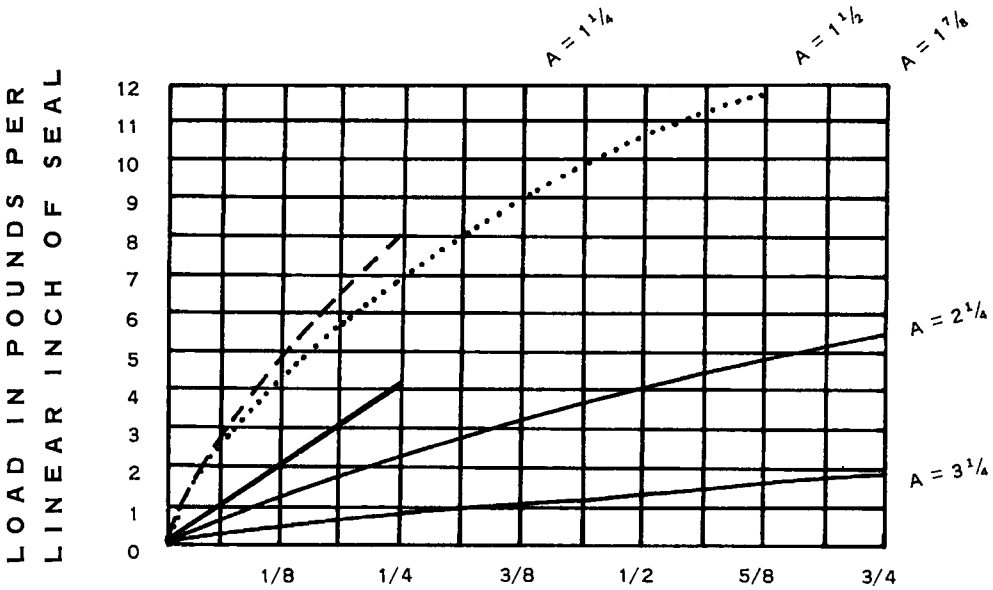
The following chart will serve as a guide for calculation of approximate loads required to compress the bulb portion of "J" seals in contemplated installations.

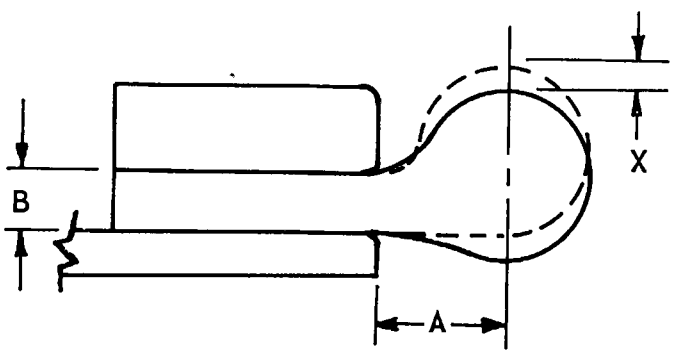
These values should be used as an approximation only because temperature, effect of aging and repeated compressive cycles of the rubber will influence the results.



THE INFORMATION CONTAINED HEREIN IS BASED UPON TESTS BELIEVED TO BE RELIABLE. HOWEVER, WE DO NOT GUARANTEE THE RESULTS TO BE OBTAINED.

DEFLECTION





B – SOLID LINE = 9/16''
B – BROKEN LINE = 3/4''
B – DOTTED LINE = 1''

LOAD REQUIRED ON A J-SEAL STEM TO PRODUCE A GIVEN AMOUNT OF DEFLECTION.

THE INFORMATION CONTAINED HEREIN IS BASED UPON TESTS BELIEVED TO BE RELIABLE. HOWEVER, WE DO NOT GUARANTEE THE RESULTS TO BE OBTAINED.

HUNTINGTON RUBBER COMPANY

RUBBER GATE SEALS

FOREWORD

The techniques used in this publication are designed to reduce the volume of information to a faster and more easily read format. All dimensions are expressed in inches unless otherwise noted.

New tooling is costly. The use of existing shapes will substantially reduce the cost of the project. Many of the more complicated molds illustrated in the following pages represent an investment of several thousand dollars. It is wise, therefore, to let the existence of a particular corner, or transition mold, be the controlling factor in the choice of the seal cross section to be employed.

As an example, the web thickness of a "J" seal or "Music-note" seal is usually of minor significance. The advantage of choosing the one for which corner structures, whether simple or complicated, are available is obvious.

In making your estimates the "guess estimate" technique should be discouraged. A "per-pound" or "per-foot" guess, even if based on costs of previous, similar seals is hazardous if any deviation should make new tooling mandatory.

Generally, we secure original plans and specifications for a project about to be bid. Thus, we may be able to respond to your inquiry if we are given the name of the project, the name of the controlling agency, the invitation number, and the date of bid opening. However, assurance of a prompt bid is more likely if drawings, specifications and your bill-of-materials accompany your inquiry.

It is our policy, whenever possible, to make a fully responsive bid. But as a service to our customers, it is also our practice to offer alternates in cases where the details are not clear--where an improved product, or a more economical but equally satisfactory approach seems possible. Such alternates, however, are not guaranteed to be suitable or acceptable. The final determination must necessarily rest with you.

New molds are constantly being added. In cases where variations from molds listed in our catalog are unavoidable an inquiry should be directed to us before making your final decisions.

In this new issue we have added a section dealing with Engineering information and suggestions. It is the result of many years of experience and the experience of others as related or conveyed to us. It is based upon our best knowledge and belief. We cannot, however, guarantee the results to be obtained.

It is hoped that this catalog will be a helpful aid to you and your organization.

(503) 246-5411

Huntington RUBBER COMPANY

KRISTIN SQUARE II · SUITE 208
9498 S.W. BARBUR BLVD.
PORTLAND, OREGON 97219
MAIL P.O. BOX 570 - 97207

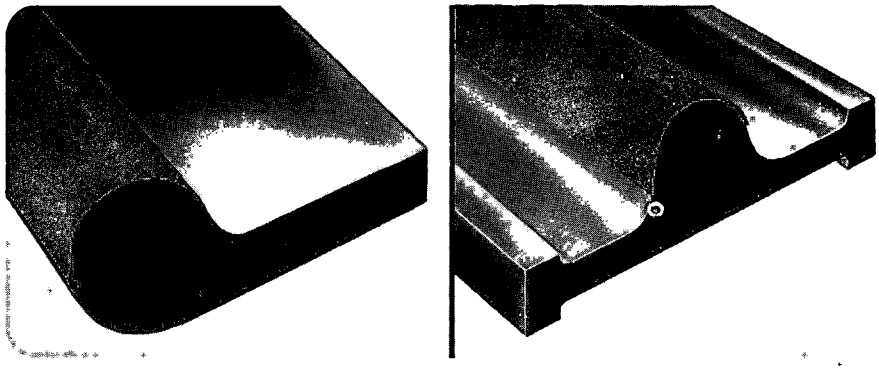
A. B. BAILEY
SALES · ENGINEER

Huntington

Rubber Gate Seals

SINCE 1937

Molded or extruded seals, fabric reinforced seals, solid or hollow bulb seals, metal-clad seals, fluoro-carbon clad seals, angle or unusual-shaped seals. Huntington makes them all, to meet nearly any hydraulic condition for low or high head dams. Hundreds of existing molds available to provide design engineers with project cost-saving advantages.



Proven to reduce seal friction load. . . abrasion resistant fluoro-carbon film

Provides very low friction load, allowing reduction in hoist capacities and savings in project costs. Substantially less per-foot cost than metal-clad seals. Enables gates to submerge readily under unbalanced heads with little or no weighting, ballasting or loading. Further details in our Gate Seals Catalog.

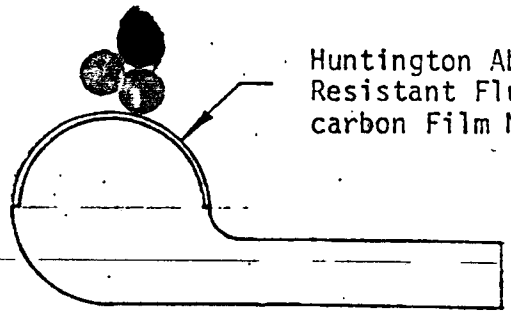
These and hundreds of other hydro projects in the world rely on Huntington Rubber Gate Seals . . .

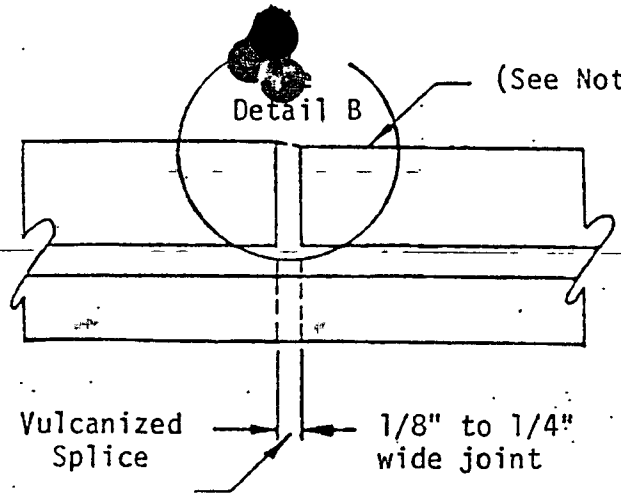
Alcantara Project, Tagus River, Spain
Cabora Bassa, Angola/Congo
D'Inga Hydro Project, Republic of Congo
Dworshak Dam, Idaho, U.S.A.
El Toro Power Plant, Southern Chile
Finchaa Hydroelectric Project, Ethiopia
Gokcekaya Dam & Hydroelectric Power Plant, Republic of Turkey
Guri Project, Venezuela
Kainji Project, Niger River, Nigeria
Kajakai Hydroelectric Project, Afghanistan
Kakki Dam, State of Kerala, India
Karnafuli Project, East Pakistan
Kremasta Hydro Project, Greece
Maskeliya Oya Project, Sri Lanka
Mica Dam, British Columbia Hydro & Power Authority, Canada
Oroville Dam, Feather River, Calif. U.S.A.
Peixoto Dam, Grande River, Brazil
Rio Prado Dam, Colombia, South America
Sadova Corabia Project, Rumania
Sainte Croix Project, France
Salado-Guayas Lock, Guayaquil, Ecuador
Tarbela Dam, Indus River, West Pakistan
Toa Vaca Dam, Puerto Rico

Design Engineers . . .
Send for complete catalog on Rubber Gate Seals. Samples of Huntington Fluoro-Carbon Film-Clad Seals and other seals also available.

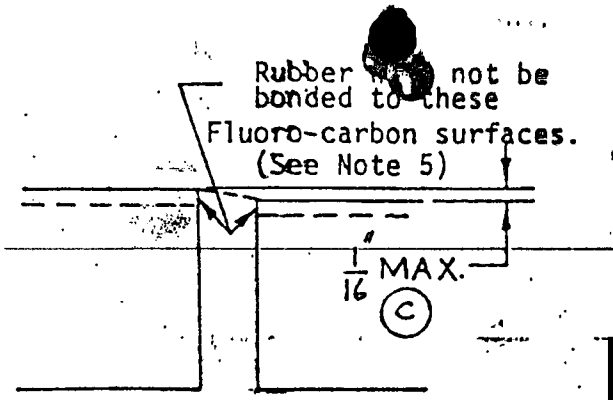
Huntington RUBBER COMPANY
7030 S.W. MACADAM • P.O. BOX 570 • PORTLAND, OREGON 97207
PHONE (503) 246-5411 • TELEX 36-0457

Printed in U.S.A.





DETAIL A



DETAIL B

NOTES:

1. Max. individual length of a single seal piece covered without any interruption of film = 9'-6".
2. Max. length of a piece fabricated by vulcanized spliced all rubber joints = approx. 25 ft.

SPLICES OF RUBBER SEALS WITH FLUORO-CARBON FILM CLADDING

3. At each splice a gap of 1/8" to 1/4" (1/2" maximum) is to be expected. This gap will be filled with rubber to the same surface plane as the adjoining film so that no leakage will result.
4. Some slight indentation or mis-alignment may occur at the all-rubber joint, (see Details A & B), because of uneven shrinkages between the rubber & film. This is not considered detrimental to the sealing effect. When hydraulic pressure is applied to the back of the seal, the nip or sealing line of the bulb evens out, creating a continuous and even seal.
5. The film will be thoroughly bonded to the rubber except that the ends shown in the above Detail B will not be bonded.

   Care must be taken to avoid handling stresses. The seal should not be bent, because plastic film may be damaged.
6. Film-clad seals cannot be tested by bonding the seal sharply at the splice, (the rubber-filled gap between the ends of the film). This is not a proper test of the adequacy of the splice and under no circumstances should this be done. The stresses are exaggerated, being centralized and concentrated only at this gap--and the force, while certainly insufficient to break the rubber-to-rubber bond and thus proving nothing--will tend to break the rubber loose from the plastic along the terminal edges--if indeed, the cladding is not also irretrievably damaged.
7. While these sketches illustrate only J, or music note seals, the circumstances herein described will apply to other seals also.
8. When the length of a seal piece is approximately 14 ft. or longer, two or more all-rubber joints may be necessary, interrupting the film cover as in Note 3.

REV. D : REDRAWN (7-23-81/AA.)

HUNTINGTON RUBBER COMPANY
DIVISION OF NEW IDRIA, INC.
PHONE 503-246-5411 P.O. BOX 570 PORTLAND, OREGON 97207 TELEX 360-457

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TITLE: SPLICES IN FLUORO-CARBON CLAD SEALS

DES.	DATE	DWN.	DAT	APP.	DATE	SCALE	TOLERANCES	DWG. NO.	REV.
[illegible]		PEH	[illegible]			-	X=± .XX=± .XXX=±	67-MNL-124	D

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SECTION – L .....BLOCKS
MOLDED BLOCKS AND PLUGS.

SECTION – M .....OPTIONS AVAILABLE WITH HUNTINGTON SEALS, MOLD NUMBER CROSS REFERENCE, AND LIST OF PROJECTS EQUIPPED WITH HUNTINGTON SEALS.

Seal illustrations used in this catalog do not show fluoro-carbon coverings or hollow bulbs, however both are available with the majority of seals produced by Huntington and if required should be so specified when ordering.

HUNTINGTON ABRASION RESISTANT FLUORO-CARBON FILM NO. 4508

Fluoro-carbon film is a plastic covering securely vulcanized and bonded to the sealing surface of rubber seals which reduces the seal's friction load to an extremely low level. Since it is introduced into the mold with the raw, unvulcanized rubber compound, it is formed, molded and vulcanized simultaneously with the rubber. This causes the film to be 'inserted' or 'recessed' into the rubber, resulting in the outer surface being flush with the surface of the rubber seal. A strong vulcanized bond between the fluoro-carbon film and the rubber takes place during this molding process.

For production in standard equipment, convenience in handling, and lower cost, seal lengths should be limited to 9'6". If mandatory, longer lengths can be made by vulcanized splicing to a maximum of 40'. At such splice joints the fluoro-carbon film will be interrupted by a gap of ⅛" to ¼", ½" maximum. Tnis gap, however, is filled with rubber to the same plane or surface as the film. Thus, no leakage, when in use, is induced.

Typical application of Fluoro-Carbon Film.

For more information regarding fluoro-carbon and other options available, refer to Engineering Information Manual.

SOLID AND HOLLOW BULB SEALS

Most Huntington molds are available either solid or hollow (with a hole through the center of the bulb section). Any size hole required is generally available. See Engineering Information Manual for more information.

M-3

1068	H-21	3033	A-10	3492	G-1	3703	C-6	4170	D-6
1743	K-1	3033-A	A-10	3492-A	G-1	3704	C-6	4171	B-1
1743-A	G-3	3053	G-4	3493	J-12	3706	B-2	4172	A-2
1743-B	G-3	3054	G-4	3494	A-1	3707	K-1	4172-A	A-7
1905	H-2	3070	A-11	3495	A-1	3707-A	K-1	4175	B-1
1905-A	H-2	3071	A-11	3506	E-4	3707-B	K-1	4176	B-1
1906	H-2	3073	A-1	3507	E-4	3708	K-5	4188	A-3
2099	A-1	3074	A-1	3508	G-2	3716	D-12	4190-A	K-7
2100	A-2	3085	A-9	3512	L-2	3717	D-12	4210-A	A-1
2247	A-2	3086	A-9	3513	L-5	3720	G-3	4218	C-8
2247-A	A-5	3087	A-6	3518	A-1	3725	D-2	4231	C-5
2247-B	A-5	3087-A	A-6	3519	J-3	3726	D-2	4231-A	C-5
2247-C	C-6	3087-B	A-6	3520	K-5	3752	J-6	4234	C-9
2283	K-1	3087-C	A-6	3533	F-5	3761	A-2	4235	C-9
2284	H-8	3087-D	A-6	3534	F-5	3761-1	E-2	4236	C-7
2329	G-4	3087-E	A-6	3536	F-5	3762	A-1	4240	F-5
2330	G-4	3087-F	A-6	3537	F-5	3763	J-9	4241	B-4
2370	A-2	3088	A-6	3538	H-19	3767	A-2	4249	K-6
2440	H-7	3088-A	A-6	3539	K-1	3792	G-4	4253	L-2
2441	H-7	3088-B	A-6	3540	K-1	3794	G-4	4258	H-5
2441-A	G-5	3088-C	A-6	3541	B-2	3796-1	E-2	4259	G-1
2513	K-2	3088-D	A-6	3542	B-2	3829	D-3	4260	H-22
2514	A-1	3088-E	A-6	3545	J-1	3839-R	F-8	4264	L-15
2532	K-2	3088-F	A-6	3547	J-6	3839-L	F-8	4275	J-8
2532-A	K-7	3171	E-3	3554	L-3	3844	A-8	4276	J-8
2553	A-4	3176	K-1	3574	L-7	3845	A-8	4278	L-1
2570	A-1	3197	H-18	3579	A-2	3858	L-3	4279	F-9
2575	A-1	3207	J-8	3587	K-5	3859	L-3	4282	H-4
2577-1	K-2	3219	A-2	3589	H-8	3885	H-18	4286	G-2
2577-2	K-2	3220	C-7	3589		3910	K-6	4287	G-2
2589	C-8	3221	C-7	MODIFIED	H-9	3932	D-10	4302	A-3
2590	C-8	3222	L-8	3592	J-3	3933	G-2	4308	F-7
2682	C-9	3223	L-8	3599	J-8	3934	G-2	4313	A-5
2683	C-9	3237	L-16	3600	J-8	3935	H-18	4314	A-5
2684	A-2	3237-A	L-16	3602	A-1	3936	H-18	4315	A-9
2685	C-2	3238	J-3	3618	D-12	3937	H-18	4316	A-9
2686	C-2	3238-A	J-3	3619	D-12	3942	B-8	4326	K-2
2765	K-1	3238-B	J-3	3621	H-20	3943	B-8	4327	L-3
2767	A-1	3238-C	H-21	3621-A	H-18	3944	K-2	4344	A-7
2773	A-3	3238-D	H-21	3622	H-20	3992	F-10	4345	A-7
2773-1	B-5	3238-E	H-21	3623	H-20	3993	F-10	4348	E-1
2774	A-2	3251	K-4	3625	A-1	4033	A-3	4349	E-1
2811	G-3	3255	L-3	3627-1	E-2	4066	L-2	4350	E-1
2812	G-3	3256	A-3	3634	H-20	4067	K-1	4351	L-18
2918	H-3	3312	K-1	3635	H-20	4068	L-14	4351-A	L-18
2933	H-3	3331	H-10	3649	F-3	4069	L-14	4351-B	L-18
2950	A-1	3363	L-1	3650	F-3	4071	A-2	4351-C	L-18
2971	K-2	3363-1	L-1	3658	A-1	4071-A	A-5	4352	A-2
2982	A-5	3368	A-2	3663	H-2	4071-B	A-5	4388	A-5
2986	A-5	3369	L-2	3677	H-1	4083	F-2	4389	A-5
2990	G-5	3375	E-5	3677-A	H-21	4084	B-8	4390	A-3
3000	A-2	3399	K-9	3678	L-9	4084-A	F-2	4396	H-8
3000-A	A-6	3403	J-4	3679	L-9	4084-B	F-3	4398	A-2
3001	C-5	3431	A-2	3684	J-12	4094	J-8	4404	B-3
3019	L-13	3435	A-2	3690	K-4	4097	E-5	4407	C-7
3020	L-13	3436	A-3	3692	K-4	4107	A-9	4414	H-22
3032	A-10	3441	F-3	3696	C-8	4114	K-8	4419	L-6
3032-A	A-10	3480	K-2	3697	C-8	4115	G-3	4422	J-6

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4429	J-13	4676	L-10	4863	B-10	5111	D-6	5416	E-6
4431	A-2	4677	K-1	4867	B-7	5114	B-4	5422	J-4
4436	L-10	4678	A-3	4868	B-7	5115	B-4	5425	K-6
4442	A-8	4680	G-3	4875	J-15	5116	C-2	5440	L-1
4442-A	A-8	4681	G-3	4876	K-3	5117	C-2	5446	L-1
4443	A-8	4686	C-1	4902	C-1	5118	A-10	5453	B-4
4443-A	A-8	4687	L-7	4903	C-1	5119	A-10	5454	B-4
4446	G-1	4694	B-8	4935	B-4	5120	D-13	5464	E-10
4447	J-1	4695	B-8	4936	B-4	5121	D-13	5465	E-10
4450	A-10	4703	C-2	4937	D-4	5129	B-6	5469	K-7
4468	A-2	4704	J-8	4938	K-6	5130	B-6	5475	L-17
4474	J-2	4705	D-7	4939	D-8	5131	H-19	5479	H-13
4477	J-3	4706	K-6	4940	D-8	5132	A-5	5497	B-4
4477-1	K-3	4708	D-13	4942	B-5	5133	A-5	5500	D-7
4485	B-6	4709	D-13	4947	E-8	5135	K-2	5538	E-3
4486	B-6	4712	J-15	4951	K-3	5137	E-5	5549	L-1
4487	F-1	4724	E-2	4952	K-3	5139	H-22	5553	L-1
4488	F-1	4725	E-2	4953	A-5	5141	J-7	5556	C-2
4490	K-8	4726	F-8	4954	A-5	5142	J-7	5566	J-8
4499	H-12	4727	A-8	4955	C-5	5143	K-2	5567	E-1
4501	L-4	4728	A-8	4955-A	C-5	5146	H-5	5568	E-1
4502	L-12	4730	J-4	4956	C-5	5149	J-16	5569	H-22
4504	H-12	4735	G-1	4956-A	C-5	5150	H-21	5574	H-20
4524	A-2	4736	B-7	4960	H-8	5166	L-6	5581	A-2
4524-A	A-5	4737	B-7	4992	F-2	5169	H-12	5583	E-7
4527	E-1	4740	A-3	5000	A-5	5172	K-2	5590	F-9
4537	E-1	4745	K-6	5001	A-5	5226	F-6	5591	F-9
4539	A-2	4746	A-3	5002	H-2	5245	J-1	5595	E-7
4543	E-4	4750	L-13	5003	H-2	5292	H-4	5596	E-7
4544	B-8	4751	L-13	5004	H-2	5298	F-4	5597	D-2
4545	B-8	4753	G-5	5005	H-2	5299	F-4	5600	C-3
4549	H-11	4754	D-1	5006	H-6	5312	L-3	5601	C-3
4558	A-3	4759	G-3	5008	G-2	5313	J-1	5603	F-10
4561	H-20	4767	H-6	5009	G-2	5315	B-9	5610	F-8
4591	J-7	4777	L-8	5019	H-13	5316	B-9	5616	H-22
4592	B-9	4778	L-7	5020	H-16	5320	C-3	5617	B-1
4593	B-9	4779	G-5	5032	B-1	5321	G-2	5618	B-1
4597	A-5	4786	L-11	5037	J-2	5323	C-3	5619	B-1
4598	A-5	4787	L-11	5038	L-17	5355	L-15	5620	B-1
4602	A-6	4788	H-6	5039	J-2	5341	K-5	5641	C-6
4603	A-2	4789	H-6	5040	G-2	5345	A-10	5642	C-6
4603-A	A-2	4795	L-3	5041	G-2	5346	A-10	5660	J-10
4604	B-3	4796	B-1	5048	L-17	5347	K-7	5661	J-10
4605	J-8	4798	A-1	5049	L-17	5349	K-8	5677	K-3
4613	J-3	4800	L-14	5050	F-6	5356	E-2	5679	H-21
4616	L-19	4801	L-14	5051	J-2	5374	J-5	5681	E-2
4617	L-12	4802	G-1	5052	J-4	5375	J-5	5688	J-8
4618	L-19	4804	G-1	5056	H-10	5382	K-7	5691	H-22
4624	A-1	4810	C-3	5068	E-3	5389	B-10	5692	D-9
4629	E-8	4811	C-3	5069	E-3	5390	B-10	5694	E-3
4646	L-15	4814	H-21	5089	A-3	5391	D-3	5695	J-4
4661	L-8	4815	G-1	5102	A-2	5392	D-3	5697	J-9
4665	F-2	4821	L-20	5103	A-3	5399	B-9	5698	A-2
4670	J-13	4822	L-20	5104	K-3	5400	B-9	5723	F-6
4671	J-13	4843	K-1	5105	K-3	5404	H-15	5736	A-5
4672	K-2	4845	L-8	5108	K-3	5406	J-9	5737	K-3
4674	D-10	4861	E-7	5109	K-3	5407	J-3	5738	B-2
4675	D-10	4862	B-10	5110	D-6	5414	K-9	5739	B-2

5746	C-1
5748	J-8
5753	H-15
5755	J-12
5756	J-12
5757	J-12
5763	K-3
5763-A	K-2
5783	H-16
5793	K-10
5798	H-18
5801	B-7
5802	F-9
5807	J-6
5826	J-7
5831	D-3
5832	H-19
5834	A-3
5840	K-10
5853	L-4
5859	H-21
5873	D-10
5874	B-7
5875	B-7
5876	C-5
5877	C-5
5879	H-5
5894	J-8
5902	L-4
5903	L-5
5910	F-7
5911	H-9
5923	L-10
5924	L-10
5930	A-5
5931	A-5
5948	A-9
5949	A-9
5951	A-2
5953	D-2
5954	D-2
5955	B-5
5966	B-5
5958	C-4
5959	C-4
5960	D-3
5960-A	D-3
5980	C-1
5986	C-9
5987	C-9
5990	J-7
5991	J-7
5992	J-7
5995	C-10
5996	C-10
5997	C-7
5998	C-7
5999	A-5
6000	A-5
6015	H-19
6016	H-19
6017	H-19
6018	H-19
6023	A-2
6040	L-9
6043	G-6
6044	B-10
6045	B-10
6046	B-1
6047	A-6
6048	A-6
6049	J-4
6050	J-4
6054	A-3
6055	A-2
6074	A-5
6075	A-5
6088	A-3
6090	C-4
6091	C-4
6097	K-4
6102	B-4
6104	D-5
6107	J-10
6113	G-5
6114	G-6
6134	L-4
6149	J-12
6151	J-2
6154	J-1
6157	J-5
6184	D-1
6190	K-4
6192	A-6
6193	A-6
6198	A-3
6198OBT	A-7
6205	D-1
6215	A-1
6235	L-9
6239	C-4
6251	H-19
6255	K-8
6257	K-8
6258	G-1
6261	H-14
6262	A-7
6263	A-7
6275	H-6
6276	J-14
6277	H-7
6278	H-7
6280	D-6
6281	D-6
6282	K-7
6283	D-4
6285	J-8
6292	H-18
6293	H-18
6295	A-4
6296-A	L-6
6296-B	L-6
6298	L-6
6301	J-9
6302	K-9
6317	A-6
6329	L-12
6336	K-9
6339	H-20
6341	H-20
6345	A-2
6346	A-9
6348	K-9
6349	B-6
6350	B-6
6360	H-17
6361	H-17
6362	H-17
6363	H-17
6371	A-2
6374	A-1
6386	C-7
6387	C-7
6404	J-1
6416	K-10
6424	L-11
6428	H-1
6435	H-1
6443	D-5
6450	K-10
6451	H-16
6471	A-2
6473	B-4
6474	B-4
6475	F-4
6486	K-4
6493	G-6
6494	G-6
6495	G-6
6501	A-1
6524	J-6
6540	H-1
6541	H-16
6560	F-8
6561	L-4
6603	G-2
6604	G-2
6609	H-14
6636	C-10
6637	C-10
6656	K-4
6678	G-6
6679	G-6
6680	G-6
6696	A-2
6704	A-2
6711	K-8
6712	K-8
6728	J-11
6729	J-11
6775	J-5
6776	L-16
6790	H-22
6797	L-17
6798	L-11
6800	H-22
6801	E-6
6804	L-16
6805	L-16
6809	E-9
6810	E-9
6812	B-3
6813	B-3
6814	B-3
6833	L-2
6835	H-22
6846	L-5
6848	A-7
6849	A-7
6853	D-9
6879	D-7
6880	A-1
6882	A-3
6884	D-8
6885	D-8
6888	A-3
6892	L-4
6895	H-22
6896	L-5
6897	H-6
6906	A-2
6907	K-4
6923	J-14
6954	H-19
6976	G-1
6977	G-1
6978	E-8
6979	E-11
6980	E-11
7001	E-11
7002	E-11
7012	D-11
7013	D-11
7025	A-3
7043	D-11
7044	J-11
7047	B-3
7048	B-3
7064	A-2
7093	D-9
7094	K-9
7113	C-10
7114	C-10
71D1397	J-6
71D1556	L-4
73D2019	J-5
74A2374	G-6
76A2917B	A-4
76A2917T	A-4
77A3566	J-5
79A4082	K-7
79A4262	J-4
79A4276	J-4
A15225	E-3
AB9544	K-6
B1-103-72	K-4
B1-521-71	G-6
B1-1214-72	G-6
B1-91-72	G-6
CC6447	K-1
CE2387	K-7
CV4497-75	K-1
DR5316	D-9
G7000	A-4
PC6315	D-13
PC9240	K-2
SB4510A	J-5
SP1538	D-5
SR8218	K-6
YM795	D-2

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THE FOLLOWING PROJECTS ARE EQUIPPED WITH HUNTINGTON SEALS

A.D. Edmonson Pumping Plant, Dept. of Water Resources, State of California, California
Affobakka Dam, Broko Pondo Project, Suriname Aluminum Co., Suriname, So. America
Albeni Falls Dam, U.S. Army Eng. District Seattle, Pend Oreille Rvr., Idaho
Alcantara, Spanish Tagus Rvr., Spain
Alcova Dam, Bur/Reclamation, North Platte Rvr., Wyoming
Algiers Lock, U.S. Army Eng. District, Etowah Rvr., Georgia
Allatoona Dam, U.S. Army Eng. District Huntington, Alum Creek, Ohio
Allegheny Reservoir Dam, U.S. Army Eng. District Pittsburgh, Allegheny Rvr., Pennsylvania
Alum Creek Reservoir, U.S. Army Eng. District Huntington, Alum Creek, Ohio
Alvin J. Wirtz Dam, Lower Colorado River Authority, Colorado Rvr., Texas
Amelia Earhart Dam, Metropolitan District Commonwealth of Massachusetts, Mystic Rvr., Massachusetts
American Falls Dam, Bur/Reclamation, Snake Rvr., Idaho
Amistad Dam, Int'l, Boundary & Water Comm., Rio Grande Rvr., U.S. & Mexico
Anderson Ranch Dam, Bur/Reclamation, So. Fork Boise Rvr., Idaho
Angeles Tunnel Intake Works, Dept. of Water Resources, State of California, California Aqueduct, West Branch Division, California
Ansonia Gates Flood Protection, Naugatuck Rvr., Connecticut
Anzaldaus Dam, Int'l Boundary and Water Comm., Rio Grande Rvr., Texas
Appleton Lower Dam, U.S. Army Eng. District Chicago, Fox Rvr., Wisconsin
Arcadia Diversion Dam, Bur/Reclamation, Little Loup Rvr., Nebraska
Argo Dam, City of Ann Arbor, Michigan
Arkansas Nuclear Plant No. 1, Arkansas
Arrow Lakes Dam, British Columbia Hydro and Power Authority, Columbia Rvr., British Columbia
Atomic Energy Station, India
Aubrey Falls Generating Station, Hydro Electric Power Co. of Ontario, Mississagi Rvr., Ontario
Auburn Dam, Commonwealth of Pennsylvania, Schuylkill Rvr., Pennsylvania
Bankhead Power Plant, Alabama Power Co., Warrior Rvr., Alabama
Barbadoes Station, Philadelphia Electric Co., Discharge Tunnel, Philadelphia
Bardwell Dam & Reservoir, U.S. Army Eng. District Fort Worth, Waxahachie Creek, Texas
Barkley Cam, U.S Army Eng. District Nashville, Cumberland Rvr., New York
Barnhart Island Project, N.Y. Power Authority, St. Lawrence Rvr., New York
Barren Reservoir No. 2 U.S. Army Eng. District Louisville, Barren Rvr., Kentucky
Barrett Chute General Station, Hydro Electric Power, Ontario, Madawaska Rvr., Canada
Barton Dam, Monroe Creek Irrigation District, Monroe Creek, Idaho
Bay d'Espoir Hydro Electric Station, Newfoundland and Labrador Power Commission
Bayou Black Structure, U.S. Army Eng. District New Orleans, Louisiana
Beaver Dam, U.S Army Eng. District Little Rock, White Rvr., Arkansas
Belden Project, Pacific Gas and Electric, California
Belews Creek Steam Station, Duke Power Co., North Carolina
Belleville Lock & Dam, U.S. Army Eng. District Huntington, Ohio Rvr., Ohio
Bersimis No.2 Dam, Hydro-Ouebec, Bersimis Rvr., Ouebec, Canada
Bertrand H. Snell Lock, U.S. Army Eng. District Buffalo, St. Lawrence Rvr., New York
Big Bend Reservoir, U.S. Army Eng. District Omaha, Missouri Rvr., South Dakota
Big Brown Creek Reservoir, Dallas Power and Light Co., Texas
Big Cliff Regulating Dam, U.S. Army Eng. District Portland, No. Santiam Rvr., Oregon
Black Butte Dam, U.S. Army Eng. District Sacramento, Stony Creek, California
Blackfoot Dam, Bur/of Indian Affairs, Blackfoot Rvr., Idaho
Black Canyon Dam, Bur of Reclamation, Payette Rvr., Idaho
Black Dog Steam Plant, Northern States Power Co., Minnesota
Blanchard Dam, (see Foster Joseph Sayers Dam)
Blue Mesa Dam, Bur/Reclamation, Gunnison Rvr., Colorado
Blue River Reservoir, McKenzie Rvr., Oregon
Bonneville Dam, U.S. Army Eng. District Portland, Columbia Rvr., Oregon
Boundary Dam, City of Seattle, Pend Oreille Rvr., Idaho
Boulder Canyon Project, Bur/Reclamation, Colorado Rvr., Nevada
Box Canyon Dam, P.U.D. No. 1 Pend Oreille Rvr., Idaho
Brandon Roads Lock & Dam, U.S. Govt., Illinois Rvr., Alberta, Canada
Brazeau Dam, Calgary Power Co., Brazeau Rvr., Alberta, Canada
Bridgeport Dam, Tarrant County Water Control and Improvement, District No.1 W. F. Trinity Rvr., Texas
Broken Bow Dam, U.S. Army Eng. District Tulsa,Mountain Fork Rvr., Oklahoma
Brownlee Dam, Idaho Power Co., Snake Rvr., Idaho
Broko Pondo Dam, South America
Browns Ferry Nuclear Plant, Tennessee Valley Authority, Alabama
Brush Creek, Muscatutuck State School, Brush Creek, Indiana
Buchanan Dam, Lower Colo. Rvr., Authority, Colorado Rvr., Texas
Buckhorn Reservoir, U.S. Army Eng. District Louisville, Middle Fork Kintucky Rvr., Kentucky
Buena Vista Pumping Plant, State of California Water Resourses, California
Buford Dam, U.S. Army Eng. District, Chatahoochee Rvr., Georgia
Buggs Island Dam (see John H. Kerr Dam)
Bull Run Steam Plant, TVA, Tenn.
Bull Shoals Dam & Reservoir, U.S. Army Eng. District Little Rock, White Rvr., Arkansas
Bullards Bar Dam, Yuba County Water Agency, North Yuba Rvr., California
Burns Harbor Plant, Lakewater State No. 2, Indiana
Cabin Creek Project, Public Service Co. of Colorado, Cabin Creek Rvr., Colorado
Cabot Dam, Western Mass. Elect. Co.
Caddoa Dam (see John Martin Dam)
Cagles Mill Reservoir, U.S. Army Eng. District Louisville, Mill Creek, Indiana
Calaveras Dam, Alamo Soil Conservation District, Calaveras Lake, Texas
Calispell Dam, Pud No. 1 Pend Oreille County, Pend Oreille River, Washington
Calcasieu Lock, U.S. Army Eng. District New Orleans, Calcasieu Rvr., Louisiana
Cal-Sag Navigation Project, U.S. Army Eng. District Chicago, Calument Rvr., Illinois
Camino Dam, Sacramento Mun. Utility Dist., Silver Creek, California
Canaveral Lock, U.S. Army Eng. District Jacksonville, Canaveral Harbor, Florida
Cannelton Lock & Dam, U.S. Army Eng. District Louisville, Ohio Rvr., Indiana
Canton Mo. Highway Flood Cont. Project, U.S. Army Eng. District Rock Island, Iowa
Canyon Dam, U.S. Army Eng. District Fort Worth, Guadalupe Rvr., Texas
Canyon Ferry Dam, Bur/Reclamation, Missouri Rvr., Montana
Captain Anthony Meldahl Lock & Dam, U.S. Army Eng. District Huntington, Ohio Rvr., Ohio
Carillon Project, Hydro-Quebec, Ottawa Rvr., Quebec, Canada
Carlyle Reservoir, U.S. Army Eng. District St. Louis, Kaskaskia Rvr., Illinois
Carmen-Smith Hydro Project, Eugene Water Board, McKenzie Rvr., Oregon
Carraizo Dam, Grande de Loiza River, Puerto Rico
Castaic Dam Outlet Works, State of California, Dept. of Water Resources, California
Carter's Dam, U.S. Army Eng. District Mobile, Coosawattee Rvr., Georgia
Catahoula Lake Diversion, U.S. Army Eng. District Vicksburg, Catahoula Lake, Louisiana
Catfish Point Control Structure, U.S. Army Eng. District New Orleans, Mermentou Rvr., Louisiana
Cazadero Dam, Portland General Electric Co., Clackamas Rvr. Oregon
Cedar Creek Dam, Kaufman-Van Zendt Soil Cons. Dist., Trinity Rvr., Texas
Chatuge Hydro Dam, TVA, Hiwassee Rvr., N. Carolina
Chalk River Nuclear Reactor, Canadian Atomic Energy, Canada
Chats Falls Generating Station, Hydro Electric Power Comm., Ottawa Rvr., Canada
Chatfield Dam and Reservoir, U.S. Army Eng. District Omaha, South Platte Rvr., Colorado
Cheakamus Dam, B.C. Power & Hydro Development, Squamish Rvr., British Columbia, Canada
Cheatham Dam, U.S. Army Eng. District Nashville, Cumberland Rvr., Tennessee
Chief Joseph Dam, U.S. Army Eng. District Seattle, Columbia Rvr., Washington
Chickamauga Lock, U.S. Army Eng. District Nashville, Chickamauga Rvr., Tennessee
Churchill Falls, Churchill Falls Labrador Corporation, Churchill Rvr., Newfoundland
Claiborne Lock and Dam, U.S. Army Eng. District Mobile, Alabama Rvr., Alabama
Cleveland Dam, Greater Vancouver Water Dist., Capilano Rvr., Vancouver, British Columbia, Canada
Cliffside Steam Plant, Duke Power Co., N. Carolina
Clifton Court Forebay Control Structure, State of California Water Resources, North San Joaquin Division, California
Clowholm Dam, B.C. Hydro & Power Authority, Clowholm Rvr., British Columbia, Canada
Colbert Steam Plant, TVA, Pickwick Lake, Alabama
Cochita Dam and Reservoir, U.S. Army Eng. District Albuquerque, Rio Grande Rvr., New Mexico
Coldbrook River Dam, U.S. Army Eng., Fall River, S. Dakota
Columbia Lock & Dam, U.S. Army Eng. District Mobile, Chattahoochee Rvr., Alabama
Conowingo Dam, Philadelphia Electric Co., Susquehanna Rvr., Maryland
Conroe Dam, San Jacinto Rvr. Authority, San Jacinto Rvr., Texas
Cooper Lake Project, Chugach Electric Assocation, Alaska
Coralville Dam, U.S. Army Eng. District Rock Island, Iowa Rvr., Iowa
Cordell Hull Project, U.S. Army Eng. District Nashville, Cumberland Rvr., Tennessee
Cougar Dam, U.S. Army Eng. District Portland, So. Fork McKenzie Rvr., Oregon
Council Grove Dam, U.S. Army Eng. District Tulsa, Neosho Rvr., Kansas
Cowans Ford, Duke Power Co., Catawba Rvr., N. Carolina
Dam No. 4, U.S. Army Eng. District Pittsburgh, Monongahela Rvr., Pennsylvania
Dardanelle Lock & Dam, U.S. Army Eng. District Little Rock, Arkansas Rvr., Arkansas
David Terry Lock & Dam, U.S. Army Eng. District Little Rock, Arkansas Rvr., Arkansas
Davis Dam, Bur/Reclamation, Colorado Rvr. Arizona
Decker Creek Dam, City of Austin, Decker Creek, Texas
De Cordova Bend Dam, Brazos Rvr. Authority, Brazos Rvr., Texas
Deer Creek Reservoir, U.S. Army Eng., Deer Creek, Ohio
Deerfield No. 5 Station, New England Power Co., Massachusetts
DeGray Reservoir, U.S. Army Eng. District Vicksburg, Caddo Rvr., Arkansas
Detroit Dam, U.S. Army Eng. District Portland, N. Santiam Rvr., Oregon
D'Inga Hydro Project, Republic of Congo, Congo
Del Valle Reservoir, State of California, Arroyo Valle Rvr., California
Devil Canyon Powerplant, Dept. of Water Resources, State of California, California

Dexter Re-regulating Dam, U.S. Army Eng. District Portland, Willamette Rvr., Oregon
Diablo Canyon Site—Unit No. 1, Pacific Gas and Electric Co., California
Dismal Swamp Canal Lock, U.S. Army Eng. District Norfolk, Atlantic Intercoastal Waterway
Don Pedro Project, Turlock Irrigation District, Tuolumne Rvr., California
Donnells Project, Oakdale & San Juan Irr. District, Middle Fork Stanislaus Rvr., California
Duncan Lake Dam, British Columbia Hydro and Electric, Columbia Rvr., British Columbia, Canada
Dworshak Dam and Reservoir, U.S. Army Eng. District Walla Walla, N. Fork Clearwater River, Idaho
Dwight D. Eisenhower Lock, U.S. Army Eng. District Buffalo, St. Lawrence Rvr., St. Lawrence Seaway
Eagle Mountain Reservoir, Tarrant County Authority No. 1, W. F. Trinity Rvr., Texas
East Lynn Reservoir Dam, U.S. Army Eng. District Huntington, Twelvepole Creek, W. Virginia
Elliott Dam, British Columbia Hydro & Power Authority, Jordan Rvr., Canada
Eklutna Dam, Bur/Reclamation, Alaska
El Cadillal Dam & Powerhouse, Prov. of Tucuman, Northern Argentina
El Toro Power Plant, Southern Chile
Elk City Dam, U.S. Army Eng. District Tulsa, Elk Rvr., Kansas
El Vado Dam, Bur/Reclamation, San Juan-Chama Project, Colorado-New Mexico
Eufaula Dam, U.S. Army Eng. District Tulsa, Canadian Rvr., Oklahoma
Eureka Lock and Dam, U.S. Army Eng. District Jacksonville, Florida Barge Canal, Florida
Exchequer Dam, Merced Irr. District, Merced Rvr., California
Falcon Dam, Int'l Boundary & Water Comm., Rio Grande Rvr., Texas
Fall Creek Reservoir, U.S. Army Eng. District Portland, Fall Creek Rvr., Oregon
Fern Ridge Dam, U.S. Army Eng. District Portland, Long Tom Rvr., Oregon
Ferrell's Bridge Dam, U.S. Army Eng. District New Orleans, Cypress Creek, Texas
First Fork Dam, Commonwealth of Penna., Sinnamahoning Creek, Pennsylvania
Finchaa Hydroelectric Project, Ethiopian Electric Light & Power, Ethiopia
Fishtrap Reservoir, U.S. Army Eng. District, Levisa Fork Rvr., Kentucky
Flaming Gorge, Bur/Reclamation, Green Rvr., Utah
Flannagan Dam, U.S. Army Eng. District Huntington, Pound Rvr., Virginia
Florida Structure 61, U.S. Army Eng. District Jacksonville, Florida
Florida Structure 65, U.S. Army Eng. District Jacksonville, So. End of Lake Kissammee, Florida
Florida Structure 79, U.S. Army Eng. District Jacksonville, Florida
Fontenelle Dam, Bur/Reclamation, Green Rvr. Wyoming
Forebay Pumping Plant, Pacific Gas & Electric Co., Fall Rvr., California
Forbestown Dam, So. Fork Feather Rvr., California
Forney Dam & Reservoir, City of Dallas, E. Fork Trinity Rvr., Texas
Fort Loudoun Lock & Dam, TVA, Tennessee Rvr., Tennessee
Fort Peck Dam, U.S. Army Eng. District Omaha, Missouri Rvr., Montana
Fort Randall Reservoir, U.S. Army Eng. District Omaha, Missouria Rvr., So. Dakota
Foster Dam, U.S. Army Eng. District Portland, South Santiam Rvr., Oregon
Foster Joseph Sayers Dam & Reservoir, U.S. Army Eng. District Baltimore, Bald Eagle Creek, Pennsylvania
Four River Basin, U.S. Army Eng. District Jacksonville, Florida
Fox Point Hurricane Bar., Corps of Engineers-New England Div., Rhode Island
Fremont Dam, Utah Water & Power Bd., Fremont Rvr., Utah
French Meadows, Placer City Water Agency, Mid. Fork American Rvr., California
Fresh Pond Project, Sacramento Municipal Utility District, California
Friant Dam, Bur/Reclamation, San Joaquin Rvr., California
Fulton River Dam, Canada Dept. of Fisheries, Fulton Rvr., British Columbia, Canada
Garrison Dam, U.S. Army Eng. District Omaha, Missouri Rvr., No. Dakota
Gaston Hydro-Elect. Power, Virginia Electric & Power Co., Roanoke Rvr., No. Carolina
Gatun—Panama Canal Locks, Panama Canal Co., Panama
Gathright Dam and Reservoir, U.S. Army Eng. District Norfolk, Jackson Rvr., Virginia
Gavin's Point Reservoir, U.S. Army Eng. District Omaha, Missouri Rvr., So. Dakota
Giboa Dam, City of New York, Schoharie Creek, New York
Gibralter Dam, Bur/Reclamation, Colorado Rvr., Arizona
Gila Project, Bur/Reclamation, Gila Gravity Main Canal Desilting Works, Arizona
Gill Dam, Turners Falls Project, Western Massachusetts Electric Co., Connecticut Rvr., Massachusetts
Gillham Dam, U.S. Army Eng., Cossatot Rvr., Arkansas
Glen Canyon Dam, Bur/Reclamation, Colorado Rvr., Arizona
Glen Elder Dam, Bur/Reclamation, Solomon Rvr., Kansas
Glendo Dam, Bur/Reclamation, North Platt Rvr., Wyoming
Gokcekaya Dam and Hydroelectric Power Plant, Republic of Turkey
Gorge High Dam, City of Seattle, Skagit Rvr., Washington
Granby Pumping Plant, Bur/Reclamation, Colorado Rvr., Colorado
Granite Shoals Dam (see Alvin J. Wirtz Dam)
Grand Coulee Dam, Bur/Reclamation, Columbia Rvr., Washington
Grand Ronde River Flume, Grande Ronde Rvr., Oregon
Green Mountain Dam, Bur/Reclamation, Blue Rvr., Colorado
Green Peter Dam, U.S. Army Eng. District Portland, Middle Santiam Rvr., Oregon
Greenup Locks & Dam, U.S. Army Eng. District Huntington, Ohio Rvr., Kentucky
Greers Ferry Dam, U.S. Army Eng. District Little Rock, Yalobusha Rvr., Mississippi
Granada Dam, U.S. Army Eng. District Vicksburg, Yalobusha Rvr., Mississippi
Guard Lock, U.S. Army Eng. District Norfolk, Inland Waterway, Louisiana
Guayabal Dam, Puerto Rico Water Resources Authority, San Juan, Puerto Rico
Guernsey Dam, North Platte Rvr., Wyoming
Guntersville Lock, TVA, Tennessee Rvr., Alabama
Guri Project, Venezuela
Hams Fork Dam, Utah Power & Light, Hams Fork Rvr., Wyoming
Hanford Atomic Project, U.S. Atomic Energy Comm., Columbia Rvr., Washington
Hannibal Locks and Dam, U.S. Army Eng. District Pittsburgh, Ohio Rvr., Ohio
Harca Development, Bolivian Power Co., Ltd., Bolivia
Harman Generating Station, Ontario Hydro., Mattagami Rvr., Ontario, Canada
Hartwell Project, U.S. Army Eng. District Savannah, Savannah Rvr., Georgia
Harry S. Truman Dam, U.S. Army Eng. District Kansas City, Osage Rvr., Missouri
Hells Canyon Dam, Idaho Power Co., Snake Rvr., Idaho
Henderson Control Project, Delmore Canal and Reservoir Co., Deep Creek, Idaho
Heron Dam, Bur/Reclamation, New Mexico
Hildebrand Lock & Dam, U.S. Army Eng. District Pittsburgh, Monongahela Rvr., W. Virginia
Hiram Chittenden Locks, U.S. Army Eng. District Seattle, Lake Washington, Washington
Hills Creek Dam, U.S. Army Eng. District Portland, Mid. Fork Willamette Rvr., Oregon
Holt Lock & Dam, U.S. Army Eng. District Mobile, Black Warrior Rvr., Alabama
Holtwood Hydro Station, Pennsylvania Power & Light, Susquehanna Rvr., Pennsylvania
Hoover Dam, City of Columbus, Big Walnut Creek, Ohio
Horse Mesa Dam & Powerhouse, Salt River Project, Salt Rvr., Arizona
Howard A. Hanson Dam, U.S. Army Eng. District Seattle, Green Rvr., Washington
Hubbard Creek Dam, W. Central Texas Mun. Water Dist., Hubbard Creek, Texas
Hugo Dam and Reservoir, U.S. Army Eng. District Tulsa, Kiamichi Rvr., Oklahoma
Hungry Horse Dam, Bur/Reclamation, So. Fork Flathead Rvr., Montana
Ice Harbor Dam, U.S. Army Eng. District Walla Walla, Snake Rvr., Washington
Imperial Diversion Dam, Bur/Reclamation, Colorado Rvr., Arizona & California
Inglis Lock, U.S. Army Eng. District Jacksonville, Florida Barge Canal, Florida
Inks Power Plant, Lower Colorado River Authority, Lower Colorado Rvr., Texas
Irrigation Control Structure, Mindanao, Republic of Phillipines
J. C. Boyle Dam, Pacific Power & Light Co., Klamath Rvr., Oregon
Jackson Lock & Dam, U.S. Army Eng. District Mobile, Warrior & Tombigbee Rvrs., Alabama
James A. Fitzpatrick Nuclear Power Plant, Power Authority, State of New York
Jocassee Station, Duke Power Company, South Carolina
John Day Lock & Dam, U.S. Army Eng. District Walla Walla, Columbia Rvr., Oregon
John W. Flannagan Reservoir, U.S. Army Eng. District Huntington, Pound Rvr., Virginia
John Hart Generating Station, B.C. Hydro & Power Authority, Campbell Rvr., British Columbia, Canada
John H. Kerr Dam, (formerly Buggs Island Dam) U.S. Army Eng. District Wilmington, Roanoke Rvr., Virginia
John Martin Dam (was Caddoa Dam) U.S. Army Eng. District Little Rock, Arkansas Rvr., Colorado
John Redmond Dam, U.S. Army Eng. District Tulsa, Neosha Rvr., Kansas
John Sevier Project, TVA, Holston Rvr., Tennessee
Johnsonville Steam Plant, TVA, Tennessee
Jones Bluff Lock and Dam, U.S. Army Eng. District Mobile, Alabama Rvr., Alabama
Jonesville Lock and Dam, U.S. Army Eng. District Vicksburg, Ouachita Rvr. and Black Rvr., Louisiana
Jordan Dam, Alabama Power Co., Coosa Rvr., Alabama
Jordan River Redevelopment, British Columbia Hydro & Power, Jordan River, British Columbia, Canada
Kainji Project, Niger Dam Authority, Niger Rvr., Nigeria
Kakki Dam, State of Kerala, India
Karnafuli, Third Unit Project, East Pakistan Gov., Karnafuli Rvr., East Pakistan
Kaskaskia River Lock & Dam, U.S. Army Eng. District St. Louis, Kaskaskia Rvr., Illinois
Kastraki Project, Greece
Kajakai Hydroelectric Project, Da Afghanistan Breshna Moassessa, Afghanistan
Kaw Dam, U.S. Army Eng. District Tulsa, Arkansas Rvr., Oklahoma
Kayouchie Coulee Flood Gates, U.S. Army Eng. District New Orleans, Gravity Drainage Dist. #4 of Calcasieu Parish, Louisiana
Kelsey Dam, Manitoba Hydro Electric Bd., Nelson Rvr., Manitoba, Canada
Kemana Project, Kitimat Rvr., British Columbia, Canada
Kendrick Project, Bur/Reclamation, North Platte Rvr., Wyoming
Kentucky Dam, TVA, Tennessee Rvr., Kentucky
Keystone Dam, U.S. Army Eng. District Tulsa, Arkansas Rvr., Oklahoma
Kiamika Reservoir, Quebec Power Authority, Kiamika Rvr., Quebec
Kinzua Project, Pennsyvania Electric, Allegheny Rvr., Pennsylvania
Kipling Generating Station, Ontario Hydro., Mattagami Rvr., Ontario, Canada
Kirkfield Lift Lock, Canadian Department of Transportation, Trent Canal, Canada
Kremasta Hydro Project, Athens, Greece
Kota Dam, Govt. of Rajasthan, Chambal Rvr., India
Kundah Dam, Govt. of Madhya Pradesh, Dudhi Nala Rvr., India
Kulamavu Dam Outlet, Idikki Hydro Electric, Cheruthoni Rvr., India
Ladore Falls Project, B.C. Hydro & Power Authority, Campbell Rvr., British Columbia, Canada
Lake Bastrop Dam, Texas
Lake Brazos Dam, City of Waco, Brazos Rvr., Texas
Lake Chelan Pumping Plant, Bur/Reclamation, Chelan Div., Manson Unit, Washington
Lake Kemp Dam, U.S. Army Eng. District Tulsa, Wichita Rvr., Texas
Lake Okeechobee Project, U.S. Army Eng. Jacksonville, St. John's Rvr., Florida
Lake Ponchartrain Project, U.S. Army Eng. District New Orleans, Louisiana
Lake Washington Ship Channel, U.S. Army Eng. District Seattle, Lake Washington, Washington

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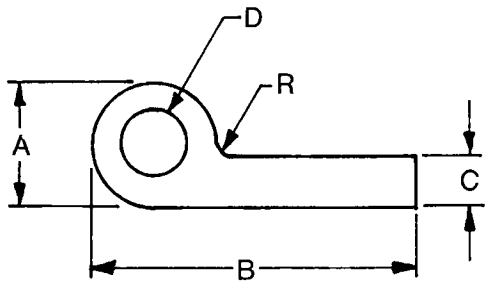
Lam Pao Project, Royal Irrigation Dept., Lam Pao Rvr., Thailand
Laurel Dam, U.S. Army Eng. District Nashville, Laurel Rvr., Tennessee
Lavon Dam, U.S. Army Eng. & North Texas Municipal Water Dist., Trinity Rvr., Texas
Lay Dam, Alabama Power Co., Coosa Rvr., Alabama
Lemay Pump Station No. 1, Hydro Quebec, Manicouagan Rvr., Quebec
Lequille Hydro Project, Nova Scotia Light & Power Co., Lequille Rvr., Nova Scotia, Canada
Lewis Creek Dam, Lewis Creek, Texas
Lewis Smith Dam, Alabama Power Co., Warrior Rvr., Alabama
Lewiston Power Project, State of N.Y. Power Authority, Niagra Rvr., New York
Libby Dam and Reservoir, U.S. Army Eng. District Seattle, Kootenai Rvr., Montana
Little Goose Lock & Dam, U.S. Army Eng. District Walla Walla, Snake Rvr., Washington
Little Long Generating Station, Ontario Hydro, Mattagami Rvr., Ontario, Canada
Little Sunflower Drainage Structure, U.S. Army Eng. District Vicksburg, Little Sunflower Rvr., Mississippi
Livington Dam, City of Houston, Trinity Rvr., Texas
Lock 3 Dam, Alabama Power Co., Coosa Rvr., Alabama
Lock 26, U.S. Army Eng. District St. Louis, Mississippi Rvr., Illinois
Lock No. 27, U.S. Army Eng. District St. Louis, Mississippi Rvr., Illinois
Lock & Dam Nos. 1, 2, 3, 4, 5, 6 & 7, U.S. Army Eng. District Little Rock, Arkansas Rvr., Arkansas
Lock & Dam No. 4, U.S. Army Eng. District Pittsburgh, Monongahela Rvr., Pennsylvania
Lock & Dam No. 6, U.S. Army Eng. District St. Paul, Mississippi Rvr., Wisconsin
Lock & Dam No. 24, U.S. Army Eng. District St. Louis, Mississippi Rvr., Missouri
Lock & Dam No. 25, U.S. Army Eng. District St. Louis, Mississippi Rvr., Missouri
Lock & Dam No. 4, 5, and 7, U.S. Army Eng. District Little Rock, Arkansas Rvr., Arkansas
Lock & Dam No. 14 and 16, U.S. Army Eng. District Tulsa, Arkansas Rvr., Arkansas
Lock & Dam 17 and 18, U.S. Army Eng. District Tulsa, Verdigris Rvr., Oklahoma
Logan Martin Dam, Alabama Power Co., Coosa Rvr., Alabama
Long Sault Project, Power Authority, State of N.Y., St. Lawrence Rvr., New York
Lookout Point Reservoir, U.S. Army Eng. District Portland, MiddleFork Willamette Rvr., Oregon
Loon Lake Penstock, Sacramento Municipal Dist., Upper American Rvr., California
Lost Creek Fish Hatchery, U.S. Army Eng. District Portland, Rogue Rvr., Oregon
Lost Creek Reservoir, Bur/Reclamation, Lost Creek, Utah
Louisville Locks & Dam, U.S. Army Eng. District Louisville, Ohio Rvr., Kentucky
L'Oved Nebaana Irrigation Project, Govt. of Tunisia
Lower Baker Dam, Puget Sound Power & Light, Baker Light, Baker Rvr.,Washington
Lower Granite Lock & Dam, U.S. Army Eng. District Walla Walla, Snake Rvr., Oregon, Washington, Idaho
Lower Monumental Locks & Dam, U.S. Army Eng. District Walla Walla, Snake Rvr., Washington
Lower Notch Generating Station, Ontario Hydro, Montreal Rvr., Ontario, Canada
Lucky Peak Dam, U.S. Army Eng. District Walla Walla, Boise Rvr., Idaho
Ludington Pumped Storage Project, Detroit Edison Co., Michigan
Mactaquac Project, New Brunswick Electric, St. John Rvr., New Brunswick
Mannoth Pool Project, So. California Edison Co., N. Fork San Joaquin Rvr., California
Mangla Dam, West Pakistan
Marion Dam, U.S. Army Eng., Cottonwood Rvr., Kansas
Manicougan No. 2 and No. 5 Dams, Quebec Hydro, Manicougan Rvr., Quebec, Canada
Markham Ferry (see Robert Kerr Project)
Markland Lock & Dam, Ohio Rvr., U.S. Army Eng. District Louisville, Ohio Rvr., Indiana
Markland Power Project, Public Service Co. of Indiana, Ohio Rvr., Indiana
Markle Levee Section, Huntington Reservoir, Indiana
Marsh Lake Dam, Yukon Territory
Marshall Steam Station, Duke Power Co., Lake Norman, North Carolina
Marshall Space Fl. Center, Miss. Test Fac. Nav. Lock, Mississippi Rvr., Mississippi
Maskeliya Oya Project, Govt. of Ceylon, Ceylon
Maxwell Locks & Dam, U.S. Army Eng. District Pittsburgh, Monongahela Rvr., Pennsylvania
Mayfield Project, City of Tacoma, Cowlitz Rvr., Washington
McAlpine Locks & Dam, U.S. Army Eng. District Louisville, Ohio Rvr., Kentucky
McArthur Lock, St. Marys Falls Canal, U.S. Army Eng. District Detroit, St. Marys Rvr.
McKinley Creek Project, Dept. of Fisheries, British Columbia, Canada
McNary Dam, U.S. Army Eng. District Walla Walla, Columbia Rvr., Oregon
Melton Hill Project Dam, TVA, Clinch Rvr., Tennessee
Metropolitan Sanitation District, City of Chicago, Illinois
Mica Dam, British Columbia Hydro & Power Authority, Columbia Rvr., British Columbia, Canada
Middle Fork, American Rvr., California
Milford Dam & Reservoir, U.S. Army Eng. District Kansas City, Republican Rvr., Kansas
Mill Creek, U.S. Army Eng. District Walla Walla, Mill Creek Lake, Washington
Millers Ferry, U.S. Army Eng. District Mobile, Alabama Rvr., Alabama
Millwood Dam, U.S. Army Eng. District Tulsa, Saline Rvr., Arkansas
Minidoka Project, Bur/Reclamation, Snake River, Idaho
Mission Dam, B.C. Hydro & Power Authority, Bridge Rvr., British Columbia, Canada
Mississinewa Reservoir, U.S. Army Eng. District Louisville, Upper Wabash & Mississinewa Rvrs., Indiana
Mississippi Lock & Dam No. 2, U.S. Army Eng. District St. Paul, Mississippi Rvr., Minnesota
Mississippi Lock & Dam No. 3, U.S. Army Eng. District St. Paul, Mississippi Rvr., Wisconsin
Mississippi Test Facility, U.S. Army Eng. District Mobile, Mississippi Rvr., Mississippi
Mississippi Lock & Dam No. 5-A, U.S. Army Eng. District St. Paul, Mississippi Rvr., Minnesota
Montague Dam, Western Massachusetts Elec., Connecticut Rvr., Massachusetts
Moose Jaw Creek Dam, Saskatchewan, Canada
Mormon Flat Dam, Salt River Project, Salt Rvr., Arizona
Morrow Point Dam, Bur/Reclamation, Gunnison Rvr., Colorado
Moss Bluff Lock & Spillway, U.S. Army Eng. District Jacksonville, Four River Basins, Florida
Mossyrock Project, City of Tacoma, Cowlitz Rvr., Washington
Mount Coffee Project. Liberia, Africa
Mount Storm Power Station, Virginia Elec. & Power Co., Stoney Rvr., W. Virginia
Mountain Chute Dam, Ontario Hydro, Madawaska Rvr., Ontario, Canada
Mousakelle Dam, Govt. of Ceylon, Maskeliya Oya Rvr., Ceylon
Muddy Run Dam, Philadelphia Elec. Co., Susquehana Rvr., Pennsylvania
Mystic River Basin, Metro. Dist. Comm., Everett-Somerville, Massachusetts
Narrett Chute Generating Station, Ontario Hydro Electric Commission, Canada
Narrows Dam, U.S. Army Eng. District Vicksburg, Little Missouri Rvr., Alabama
Navajo Dam, Bur/Reclamation, San Juan Rvr., New Mexico
Navarro Mills Project, U.S. Army Eng. District Fort Worth, Richland Creek, Texas
Neches Project, Lower Neches Valley Authority, Texas
New Bedford-Fairhaven Hurricane Barrier, Corps/Eng. Div. New England, New Bedford, Massachusetts
New Cumberland Lock & Dam, U.S. Army Eng. District Pittsburgh, Ohio Rvr., W. Virgina
New Hope Project, U.S. Army Eng. District Wilmington, Cape Fear Rvr. Basin, North Carolina
New Melones Reservoir, U.S. Army Eng. District Sacramento, Stanislaus Rvr., California
Newburgh Locks and Dam, U.S. Army Eng. District Louisville, Ohio Rvr., Indiana
New Savannah Bluff Lock & Dam, U.S. Army Eng. District Savannah, Savannah Rvr., Georgia
Niagara Generating Plant, State of N.Y. Power Authority, Niagara Rvr., New York
Nickajack Project, TVA, Tennessee Rvr., Tennessee
Nine Mile Point Nuclear Station, Virginia Elec. & Power Co., Virginia
Nolin Reservoir, U.S. Army Eng. District Louisville, Nolin Rvr., Kentucky
North Anna Power Station, Virginia Elec. & Power Co., Virginia
Northfield Mountain Pumped Storage Project, Connecticut Light & Power Co., Massachusetts
North Fork Dam, Portland General Electric Co., Clackamas Rvr., Oregon
North Fork Pound Reservoir, U.S. Army Eng. District Huntington, Pound Rvr., Virginia
No. Springfield Dam & Reservoir, U.S. Army Eng. District, Black Rvr., Vermont
Norton Dam, Bur/Reclamation, Prairie Dog Creek, Kansas
Nottely Hydro Plant. TVA, Nottely Rvr., Georgia
Oahe Reservoir, U.S. Army Eng. District Omaha, Missouri Rvr., S. Dakota
Oconee Nuclear Station, Duke Power Co., S. Carolina
Okatibbee Dam, U.S. Army Eng. District Mobile, Okatibbee Creek, Mississippi
Old Harbor Power Station, Jamaica Public Service Co., Ltd., Jamaica
Old Hickory Dam, U.S. Army Eng. District Nashville, Cumberland Rvr., Tennessee
Old River Navigation Lock, U.S. Army Eng. District New Orleans, Old Rvr., Mississippi
Oologah Dam, U.S. Army Eng. District Tulsa, Verdigris Rvr., Oklahoma
Opekiska Lock & Dam, U.S. Army Eng. District Pittsburgh, Monongahela Rvr., W. Virginia
Optima Dam, U.S. Army Eng. District Tulsa, Northern Canadian Rvr., Oklahoma
Oroville Dam, State of California Dept. of Water Resources, Feather Rvr., California
Orwell Dam, U.S. Army Eng. District St. Paul, Otter Tail Rvr., Minnesota
Outardes III Project, Hydro Quebec, Outardes Rvr., Quebec
Owyhee Dam, Bur/Reclamation, Owyhee Rvr., Oregon
Oxbow Dam, Idaho Power Co., Snake Rvr., Oregon-Idaho
Ozark Lock & Dam, Little Rock District, U.S. Army Engineers, Arkansas Rvr., Arkansas
Paint Creek Reservoir, City of Stamford, Paint Creek, Texas
Palisades Dam, Bur/Reclamation, So. Fork Snake Rvr., Idaho
Pamba Dam, Pamba Rvr., India
Panama Canal, Panama Canal Co., Panama
Paradise Steam Plant, TVA
Parker-Davis Project, Bur/Reclamation, Colorado Rvr., Arizona
Peach Bottom Atomic Power Station, Philadelphia Elec. Co., Susquehana Rvr., Pennsylvania
Peixoto Dam, Cia. Paulista de Forca, Grande Rvr., Brazil
Pelton Dam, Portland General Elec. Co., Deschutes Rvr., Oregon
J. Percy Priest Reservoir, U.S. Army Eng. District Nashville, Stones Rvr., Tennessee
Perry Dam & Reservoir, U.S. Army Eng. District Kansas City, Delaware Rvr., Tennessee
Pickwick Landing Lock, TVA, Tennessee Rvr., Tennessee
Pike Island Lock & Dam, U.S. Army Eng. District Pittsburgh, Ohio Rvr., Onio
Pillur Dam, Kundah Hydro Elec. Project, Dhamnod, India
Pine Creek Reservoir, Alleghany County, Pine Creek, Pennsylvania
Pleasant Valley Pumping Station, Los Angeles Water & Power,Owens Rvr., California

Pomme de Terre Dam, U.S. Army Eng. District Kansas City, Pomme de Terre Rvr., Missouri
Port Allen Locks, U.S. Army Eng. District New Orleans, Mississippi Rvr., & Gulf Intercoastal Waterway, Louisiana
Portage Mountain Project, B. C. Hydro & Power Authority, Peace River, British Columbia, Canada
Possum Kingdom Dam, Brazos River Authority, Brazos Rvr., Texas
Powell River Project, MacMillon, Bloedel, Ltd., Powell Rvr., British Columbia, Canada
Priest Rapids Dam, P.U.D. of Grant County, Washington, Columbia Rvr., Washington
Proctor Dam, U.S. Army Eng. District Fort Worth, Leon Rvr., Texas
Putah Diversion Dam, Bur/Reclamation, Solano Rvr., California
Qu'Appelle River Dam, Qu'Appelle Rvr., Saskatchewan, Canada
Quebec Canals Locks, Dept. of Transport, Quebec, Canada
Racine Lock & Dam, U.S. Army Eng. District Huntington, Ohio Rvr., W. Virginia
Ralston After-Bay Dam, Middle Fork American Rvr., California
Rayasthan Atomic Energy Project, Govt. of India
Raystown Reservoir, Pennsylvania Elec. Co., Raystown Branch of Juaniata Rvr., Pennsylvania
Red Bluff Diversion Dam, Bur/Reclamation, Sacramento Rvr., California
Red River Floodway, Red Rvr., Manitoba, Canada
Red Rock Dam, U.S. Army Eng. District Rock Island, Des Moines Rvr., Iowa
Rio Prado Dam, Colombia, South America
Robert Lee Dam, Colorado River Municipal Water District, Colorado Rvr., Texas
Robert S. Kerr Lock & Dam, Grand River Authority, Grand Rvr., Oklahoma
Rock Island Dam, P.U.D. No. 1 of Chelan County, Columbia Rvr., Washington
Rocky Reach Project, P.U.D. No. 1 of Chelan County, Columbia Rvr., Washington
Ross Barnett Reservoir Spillway, State of Mississippi, Pearl Rvr., Mississippi
Round Butte Dam, Portland General Elec. Co., Deschutes Rvr., Oregon
Roza Diversion Dam, Bur/Reclamation, Yakima Rvr., Washington
Ruedi Dam, Bur/Reclamation, Fryingpan Rvr., Colorado
Sabarigiri Dam, State of Kerala, India, Pambayar Rvr., India
Sacramento Ship Channel, U.S. Army Eng. District Sacramento, Sacramento Rvr., California
Sadova Corabia Project, English Electric Co., Ltd., Rumania
St. Anthony Falls Lock & Dam, U.S. Army Eng. District St. Paul, Mississippi Rvr., Minnesota
St. Mary's Falls Canal, U.S. Army Eng. District Detroit, St. Mary's Rvr.
St. Ours Project, St. Ours, Canada
Salado-Guayas Lock, Guayaquil, Ecuador, South America
Salamonie Reservoir, U.S. Army Eng. District Louisville, Salamonie Rvr., Indiana
Salina Storage Project, San Luis Obispo County, Salinas Rvr., California
Salt River Reservoir, Bur/Reclamation, Salt Rvr., Arizona
Sam Rayburn Dam (formerly McGee Bend Dam), U.S. Army Eng. District Fort Worth, Angelina, Rvr., Texas
San Antonio River Project, Monterey Cty. Fire & Water Control District, San Antonio Rvr., California
San Fernando Project, Los Angeles Water & Power, San Fernando Creek, California
Sanford Dam, Bur/Reclamation, Canadian Rvr., Texas
San Joaquin River Project, U.S. Army Eng. District Sacramento, San Joaquin Rvr., California
San Luis Canal, Bur/Reclamation, San Luis Creek, California
Santa Branca Dam, Venezuela, South America
Santee Dam, South Carolina Public Services Authority, Santee Rvr., South Carolina
Sault St. Marie Lock, St. Lawrence Seaway, Michigan
Saylorville Reservoir, U.S. Army Eng. District Rock Island, Des Moines River, Iowa
Seaton Lake Dam, British Columbia, Canada
Seminole Generating Station, Oklahoma Gas & Electric, Oklahoma
Seneca Power Station, Pennsylvania Elec. and Cleveland Elec. Illumination Co., Allegheny Rvr., Pennsylvania
Sequoyah Nuclear Plant, TVA, Arkansas
Shannondale Dam & Reservoir, Shannondale, Inc., Furnace Run Rvr., W. Virginia
Shasta Dam, Bur/Reclamation, Sacramento Rvr., California
Shawnee Steam Plant, TVA, Kentucky
Shelbyville Reservoir, U.S. Army Eng. District St. Louis, Kaskaskia Rvr., Illinois
Shenango Dam, U.S. Army Eng. District Pittsburgh, Shenango Rvr., Pennsylvania
Smith Mountain Project, Appalachian Power Co., Roanoke Rvr., W. Virginia
Snake Creek Pumping Plant No. 1, Bur/Reclamation, Missouri Rvr. Basin, N. Dakota
Snare Falls Dam, Northern Canada Power Comm., Snare Rvr., Northwest Territories, Canada
Snettisham Project, U.S. Army Engineers, Alaska
South Saskatchewan River Project, Canada Dept. of Agriculture, Saskatchewan Canada
Spring Bank Reservoir No. 3, Ontario, Canada
Spring Creek Power Conduit, Bur/Reclamation, Spring Creek, California
Squaw Rapids Dam, Province of Sask. Power Corp., Saskatchewan Rvr., Saskatchewan Rvr., Saskatchewan, Canada
St. Lawrence Seaway—Dwight D. Eisenhower Lock—Bertrand H. Snell Lock
Sterling Rock Falls Dam, U.S. Army Eng. District Rock Island, Rock Rvr., Illinois
Stewart Mountain Dam, Bur/Reclamation, Salt Rvr., Arizona
Stewartville Generating Station, Hydro-Electric Power Comm., Madawaska Rvr., Ontario, Canada
Stockton Dam, U.S. Army Eng. District Kansas City, Sac Rvr., Missouri
Sugar Loaf Dam, Lake Fork Rvr., Colorado
Superior Dam, Bur/Reclamation, Republican Rvr., Nebraska
Sutton Reservoir, U.S. Army Eng. District Huntington, Elk Rvr., W. Virginia
Swift Project, Pacific Power & Light co., Lewis Rvr., Washington
Table Rock Dam, U.S. Army Eng. District Little Rock, White Rvr., Mississippi
Tarabela Dam, West Pakistan Water & Power Development Authority, Indus Rvr., R. Pindi, Pakistan
Taltson River Hydro Dev., Twin Gorges, Northwest Territory, Canada
Taum Sauk Power Plant, Union Elec. Co., Black Rvr., Missouri
Tehachapi Pumping Plant, California State Water Resources Authority, California
Tenkiller Ferry Dam, U.S. Army Eng. District Tulsa, Illinois Rvr., Oklahoma
Terminus Project, U.S. Army Eng. District Sacramento, Kaweah & Tule Rvrs., California
The Dalles Dam, U.S. Army Eng. District Portland, Columbia Rvr., Oregon-Washington
Theodore Roosevelt Dam, Bur/Reclamation, Salt Rvr., Arizona
Thermalito Power Plant, California Dept. of Water Resources, Feather Rvr., California
Tiber Dam, Bur/Reclamation, Marias Rvr., Montana
Tide Control Structure, U.S. Army Eng. District Galveston, Galveston Bay, Texas
Tims Ford Project, TVA, Tennessee
Toa Vaca Dam, Puerto Rico Water Resources Authority, Toa Vaca Rvr., Villalba, Puerto Rico
Toledo Bend Dam, Sabine River Authority, Sabine Rvr., Texas-Louisiana
Tolt River Dam, City of Seattle, So. Fork Tolt Rvr., Washington
Townshed Dam, U.S. Army Eng. District Waltham, West Rvr., Vermont
Tradinghouse Creek Project, Texas Power & Light, Tradinghouse Creek, Texas
Trempealeau Lock & Dam No. 6, U.S. Army Eng. District St. Paul
Trinidad Reservoir, U.S. Army Eng. District New Mexico, Purgatoire Rvr., Colorado
Trinity Dam, Bur/Reclamation, Trinity Rvr., California
Trojan Nuclear Project, Portland General Elec. Co., Columbia Rvr., Oregon
Troy Fish Dam, Oregon Fish Comm., Oregon
Tuckertown Dam, Yadkin, Inc. (Aluminum Corp. of America), Yadkin Rvr., N. Carolina
Tulloch Project, Oakdale & San Joaquin Irr. District, Middle Fork Stanislaus Rvr., California
Tunisia Dam Project, Tunisia, Africa
Turners Fall Project, Western Massachusetts Elec. Co., Connecticut Rvr., Massachusetts
Tuscarora Project, State of N.Y. Power Authority, Niagara Rvr., New York
Tuttle Creek Dam, U.S. Army Eng. District Kansas City, Big Blue Rvr., Kansas
Twin Buttes Dam, Bur/Reclamation, Middle & So. Fork Concho Rvr., Kansas
Two Lick Creek Dam, Pennsylvania Elec. Co. and New York State Elec. & Gas, Two Lick Creek, Pennsylvania
Two River Project, U.S. Army Eng. District Albuquerque, New Mexico
Uniontown Lock & Dam, U.S. Army Eng. District Louisville, Ohio Rvr., Kentucky
Upper Campbell Lake Dam, British Columbia, Canada
Verdigris Lock & Dam, U.S. Army Eng. District Tulsa, Verdigris Rvr., Oklahoma
Vermillion Lock, U.S. Army Eng. District New Orleans, Louisiana
Vermont Yankee Nuclear Power Station, Vermont Yankee, Vermont
Waco Dam, U.S. Army Eng. District Fort Worth, Bosque Rvr., Texas
Wahleach Dam, B.C. Hydro Power Authority, Wahleach Rvr., British Columbia, Canada
Wahluke Branch Canal, Bur/Reclamation, Columbia Rvr., Washington
Wallisville Reservoir, U.S. Army Eng. District Galveston, Trinity Rvr., Texas
Walter F. George Dam, U.S. Army Eng. District Mobile, Chattahoochee Rvr., Georgia
Wanapum Dam, P.U.D. of Grant County, Columbia Rvr., Washington
Waneta Dam #6, Consolidated Mining & Smelting Co., Pend D'Oreille Rvr., British Columbia, Canada
Warsak Dam, West Pakistan Government, Kabul Rvr., West Pakistan
Warrior Lock & Dam, U.S. Army Eng. District Mobile, Black Warrior Rvr., Alabama
Watts Bar Dam, TVA, Tennessee Rvr., Tennessee
Webbers Falls, U.S. Army Eng. District Tulsa, Arkansas Rvr., Oklahoma
Weiss Dam, Alabama Power Co., Coosa Rvr., Alabama
Welland Shio Canal, Ontario, Canada
Wells Generating Station, Hydro Elec. Power Co., Ontario, Canada
Wells Hydro Project, P.U.D. No. 1 of Douglas County, Columbia Rvr., Washington
West Delaware Tunnel, New York City Board of Water Supply
West Point Project, U.S. Army Eng. District Savannah, Chattahoochee Rvr., Alabama and Georgia
Wheeler Hydro Plant, TVA, Tennessee Rvr., Alabama
White Oak Creek Dam, Sulpher Springs Water District, Texas
Whitehorse Rapids Project, Northern Canada Power Comm., Yukon Rvr., Yukon
White River Backwater Levee, U.S. Army Eng. District Little Rock, White Rvr., Arkansas
White Shell Reactor, Canadian Atomic Energy, Manitoba, Canada
Whittier Narrows Dam, U.S. Army Eng. District Los Angeles, San Gabriel Rvr., California
Widows Creek Plant, TVA, Guntersville Lake, Alabama
Wilkesboro Dam, U.S. Army Eng. District Charleston, Yadkin Rvr., N. Carolina
Willamette Falls Locks, U.S. Army Eng. District Portland, Willamette Rvr., Oregon
Willow Island Lock & Dam, U.S. Army Eng. District Huntington, Ohio Rvr.
Wilson Project, TVA, Tennessee Rvr., Alabama
Wirtz Dam, Lower Colorado River Authority, Lake Lyndon B. Johnson, Texas
Wisconsin Power Co. Dam, Prairie du Sac, Wisconsin
Wynoochee Dam Reservoir Project, U.S. Army Eng. District Seattle, Wynoochee Rvr., Washington
Yadkin Falls Dam, Tallassee Power Co. (Aluminum Corp. of America), Yadkin Rvr., N. Carolina
Yazoo Backwater Project, U.S. Army Eng. District Vicksburg, Mississippi Rvr., Mississippi
Yellowtail Dam, Bur/Reclamation, Bighorn Rvr., Montana

A-1



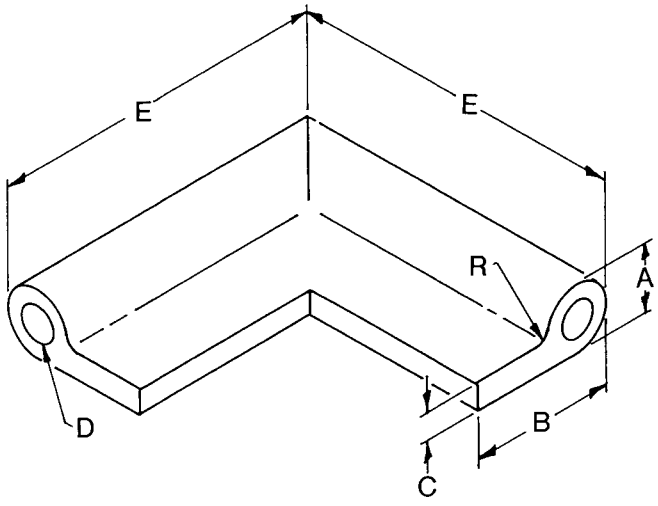
NO.	A	B*	C	D**	R
3625	7/8	2 1/4*	5/16	**	1/8
2570	1	4 1/2*	1/2	**	7/16
6880	1	6*	5/16	**	3/8
6215	1 1/4	4*	1/2	**	3/16
6501	1 1/2	5*	1/2	**	1/4
2514	1 3/4	6 1/4*	9/16	**	5/16
2767	1 3/4	5*	11/16	**	1/4
2575	1 3/4	6*	7/8	**	5/16
3762	1 3/4	6*	3/4	**	5/16
6374	2	6*	3/4	**	1/4
3073	2	6*	7/8	**	3/16
3495	2	6*	1	**	1/4
4798	2 1/8	6*	3/4	**	3/8
4210-A	2 1/4	6*	9/16	**	5/16
3658	2 1/4	9*	3/4	**	5/16
2099	2 1/4	9*	1	**	1/4
4624	2 3/8	7*	1	**	1/4
3494	2 1/2	5*	1	**	1/2
3602	2 1/2	6*	7/8	**	3/4
2950	2 3/4	9 1/4*	1	**	3/8
3518	2 3/4	9 1/4*	3/4	**	3/8
3074	3	7*	1	**	7/16

* MOLDS WILL PRODUCE ANY WIDTH LESS THAN MAXIMUM.

** MOLDS WILL PRODUCE EITHER SOLID BULB SEALS OR SEALS WITH ANY SIZE HOLE REQUIRED.

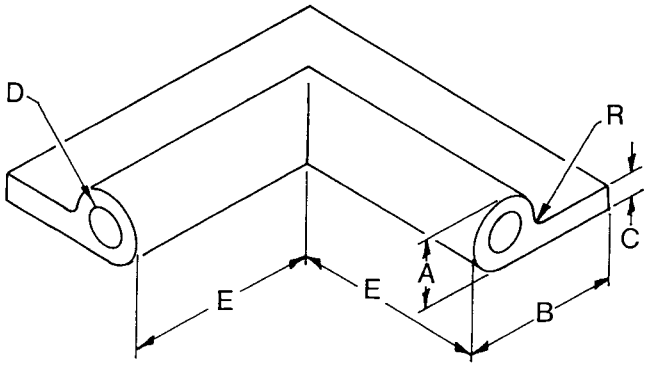
WHEN THESE MOLD NUMBERS ARE SPECIFIED IT WILL BE ASSUMED, IN THE ABSENCE OF QUALIFYING DESCRIPTIONS, THAT THE CROSS SECTION IS SOLID, (WITHOUT CENTER HOLE IN THE BULB), THE FULL WIDTH SHOWN, AND WITHOUT FABRIC OR FLUORO-CARBON COVERING.

A-2



FLAT OUTSIDE BULB

NO.	A	B*	C	D**	E	R
3761	7/8	2 1/4*	5/16	**	10	1/8
6696	7/8	2 1/4*	5/16	**	4 3/8	1/8
5951	7/8	4 5/16*	1/2	**	16	3/8
6906	1	6*	5/16	**	12	3/8
3368	1	4 1/2*	1/2	**	15	7/16
6704	1 1/4	4*	1/2	**	15	3/16
6371	1 3/4	5*	3/4	**	***	5/16
4524	1 3/4	5*	9/16	**	***	7/16
2247	1 3/4	5*	9/16	**	16	5/16
4071	1 3/4	6 1/4*	9/16	**	24	5/16
2774	1 3/4	5*	11/16	**	20	5/16
5698	1 3/4	6*	7/8	**	***	5/16
3431	2	6*	7/8	**	15	3/16
5102	2	6*	1	**	16	1/4
6345	2	6*	1	**	16	1/4
4603-A	2 1/4	6*	9/16	**	18	5/16
4603	2 1/4	9*	3/4	**	18	5/16
2370	2 1/4	6*	1	**	16	1/4
5581	2 1/4	7*	1	**	21	1/4
2684	2 3/8	6*	1	**	16 1/2	1/4
3767	2 1/2	6*	7/8	**	15	3/8
4172	2 3/4	6*	1	**	***	3/8
4539	2 3/4	9*	1	**	18	3/8
4468	3	7*	1	**	18	7/16



FLAT INSIDE BULB

NO.	A	B*	C	D**	E	R
4398	7/8	2 1/4*	5/16	**	11 1/4	1/8
4352	1	4 1/2*	1/2	**	13	7/16
6471	1 1/4	4*	1/2	**	***	3/16
3000	1 3/4	6 1/4*	9/16	**	14 1/4	5/16
6023	1 3/4	6*	3/4	**	12	5/16
4431	2	6*	1	**	***	1/4
3435	2 1/4	6 1/8*	3/4	**	10 1/8	5/16
2100	2 1/4	5 3/4*	1	**	9 1/4	1/4
6055	2 3/4	6*	3/4	**	***	3/8
3579	2 3/4	9 1/4*	1	**	8 3/4	3/8
3219	2 3/4	6*	1	**	18	3/8
7064	3	7*	1	**	14 1/2	7/16

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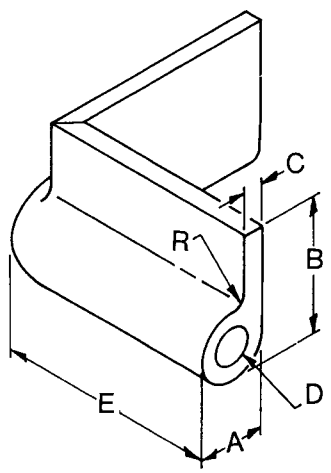
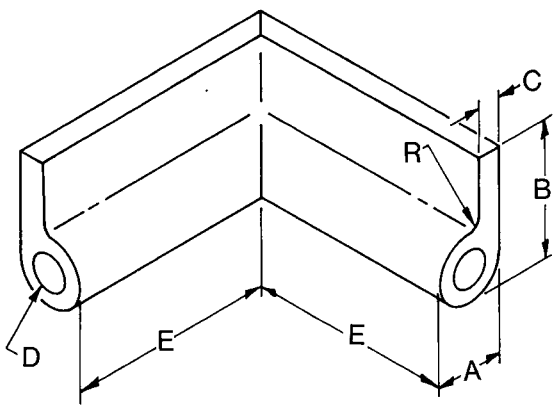
WHEN THESE MOLD NUMBERS ARE SPECIFIED IT WILL BE ASSUMED, IN THE ABSENCE OF QUALIFYING DESCRIPTIONS, THAT THE CROSS SECTION IS SOLID, (WITHOUT CENTER HOLE IN THE BULB), THE FULL WIDTH SHOWN, AND WITHOUT FABRIC OR FLUORO-CARBON COVERING.



VERTICAL OUTSIDE BULB

NO.	A	B*	C	D**	E	R
4558	7/8	2 1/4*	5/16	**	***	1/8
5834	7/8	2 1/4*	5/16	**	9	1/8
6198	1	4 1/2*	1/2	**	***	7/16
6888	1 1/4	4*	1/2	**	15	3/16
2773	1 3/4	5*	9/16	**	12 3/4	5/16
4033	1 3/4	6*	9/16	**	16	5/16
4188	1 3/4	4*	11/16	**	16	5/16
4746	1 3/4	5*	11/16	**	16	5/16
5103	1 3/4	5*	3/4	**	***	5/16
4678	2	6*	7/8	**	16	5/16
4740	2	6*	1	**	20	1/4
6074	2 1/4	6*	3/4	**	16	5/16
4390	2 1/4	6*	1	**	16	1/4
3256	2 3/4	6*	1	**	14 1/2	3/8

*** AS REQUIRED



VERTICAL INSIDE BULB

NO.	A	B*	C	D**	E	R
5089	7/8	2 1/4*	5/16	**	9 3/4	1/8
6088	1	4 1/2*	1/2	**	***	7/16
4302	1 3/4	6*	9/16	**	16	5/16
6882	1 3/4	6*	3/4	**	12	5/16
3436	2 1/4	4 7/8*	3/4	**	15	5/16
7025	2 3/4	7*	1	**	12	3/8
6054	2 3/4	6*	3/4	**	***	3/8

*** AS REQUIRED

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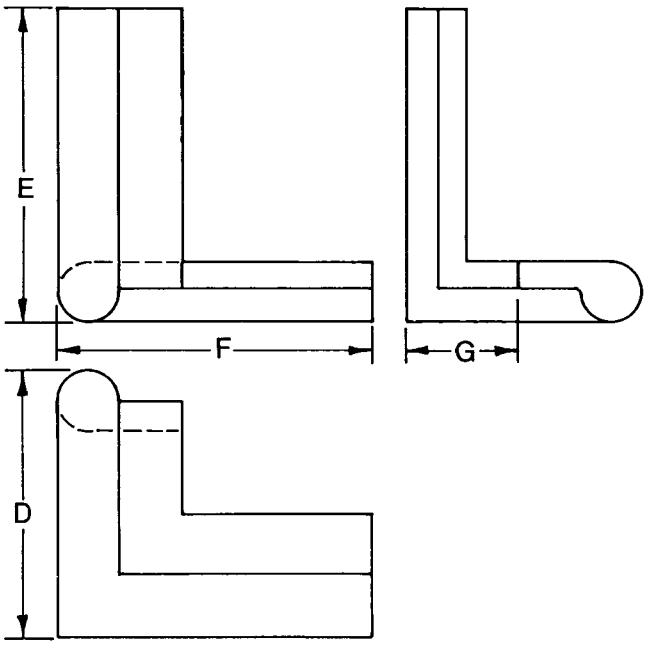
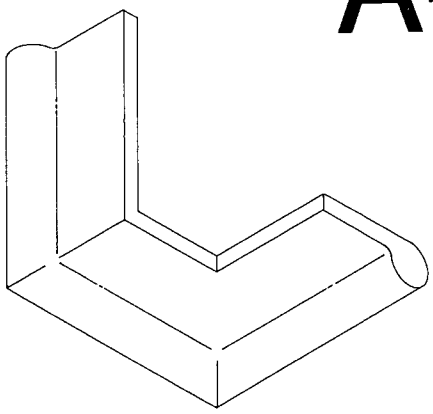
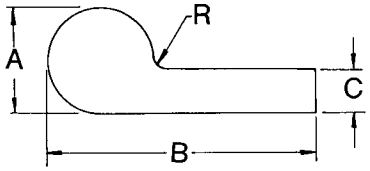
** MOLDS WILL PRODUCE EITHER SOLID BULB SEALS OR SEALS WITH ANY SIZE HOLE REQUIRED.

WHEN THESE MOLD NUMBERS ARE SPECIFIED IT WILL BE ASSUMED, IN THE ABSENCE OF QUALIFYING DESCRIPTIONS, THAT THE CROSS SECTION IS SOLID, (WITHOUT CENTER HOLE IN THE BULB), THE FULL WIDTH SHOWN, AND WITHOUT FABRIC OR FLUORO-CARBON COVERING.

A-5



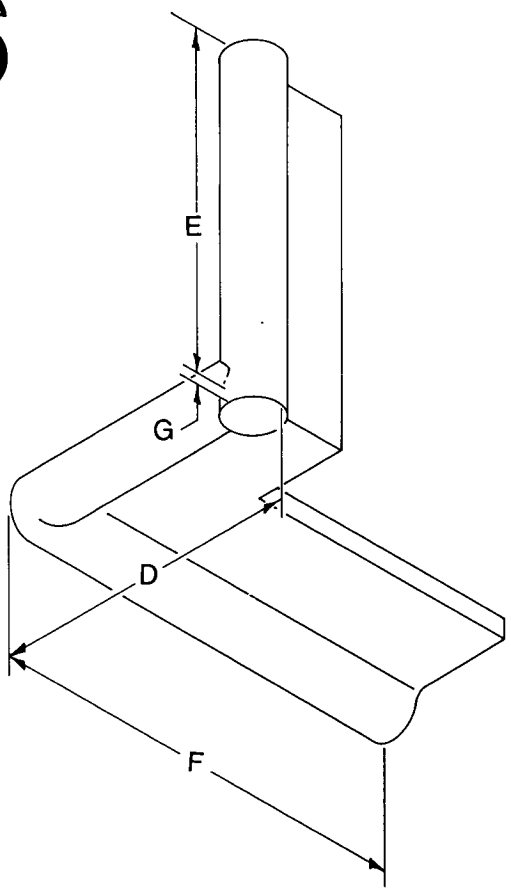


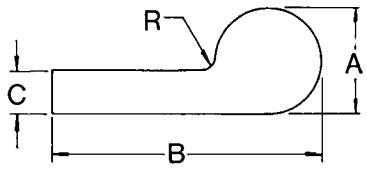


MOLD NO.	A	B	C	D	E	F	G	R
2982 & 2986	2 1/2	4 3/4	1	10 3/8	12	12	5 5/8	1/4 R
5132 & 5133	2 1/4	5	3/4	8 3/4	16	18	3 3/4	5/16R
2247A & OPP.	1 3/4	5 **	9/16	7*	16	***	2*	5/16R
4071A & OPP.	1 3/4	6 **	9/16	11 1/4*	16	***	5 1/4*	5/16R
4524A & OPP.	1 3/4	6**	9/16	12 1/8	16	***	6 1/8*	5/16R
2247B & OPP.	1 3/4	4**	9/16	6 3/4*	16	***	2 3/4*	5/16R
4597 & 4598	7/8	2 1/4	5/16	6 3/16* 12**	10*	11**	3 15/16* 9 3/4**	1/8R
5000 & 5001	1 3/4	5	3/4	9 1/16	17	17	4 1/16	5/16R
4953 & 4954	1	4 1/2	1/2	5 11/16	10	10	1 3/16	5/16R
5999 & 6000	1 3/4	6	7/8	7 3/8	12	15	1 3/8	5/16R
5736 & OPP.	1 3/4	5**	11/16	10 1/2	16	***	5 1/2*	1/4R
6074 & 6075	2 1/4	6	3/4	10	16	16	4	5/16R
4313 & 4314	2	4 3/4	7/8	10 1/2	***	15	5 3/4	5/16R
4388 & 4389	2 1/4	4 3/4	1	7	***	12	3 1/4	1/4R
5930 & 5931	1 3/4	4	9/16	6 1/8	16**	***	2 1/8	5/16R
4071B & OPP.	1 3/4	6**	9/16	8*	16**	***	2*	5/16R

*** AS REQUIRED ** MAX. * MIN.

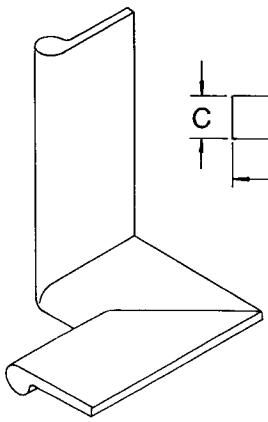
A-6

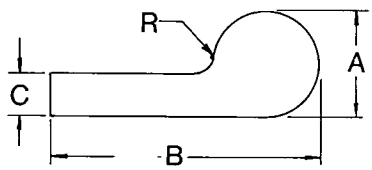


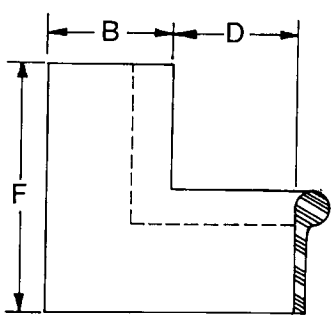


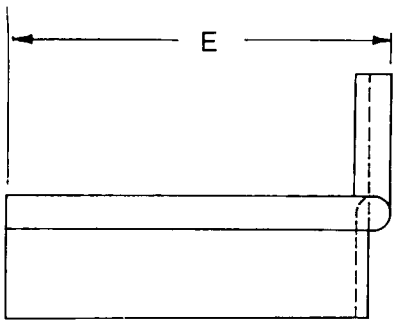
MOLD NO.	A	B	C	D	E	F	G	R
3087 & 3088	1¾	5	11/16	7¾	14½	13½	¼	¼R
3087A & 3088A	1¾	5	11/16	8 3/16	14½	13½	¼	¼R
3087B & 3088B	1¾	5	11/16	7⅛	14½	13½	¼	¼R
3087C & 3088C	1¾	5	11/16	8⅛	14½	13½	¼	¼R
3087D & 3088D	1¾	5	11/16	8⅜	14½	13½	¼	¼R
3087E & 3088E	1¾	5	11/16	10	14½	13½	¼	¼R
3087F & 3088F	1¾	5	11/16	12	14½	13½	¼	¼R
6317 & OPP.	~~1¾~~ 7/8	2¼	5/16	3⅛	10	10	—	⅛R
6192 & 6193	1¾	4	9/16	8	12*	12*	—	5/16R

*MIN.



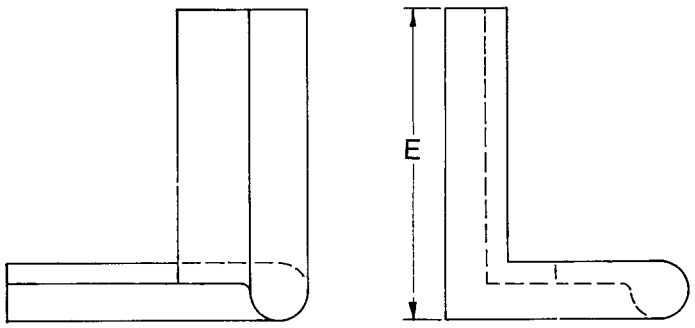


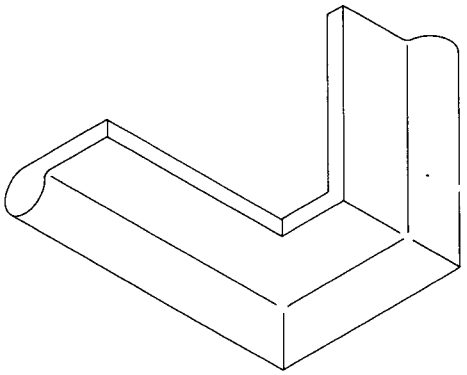


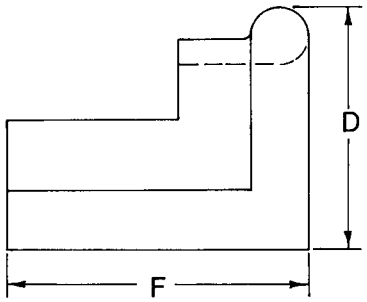


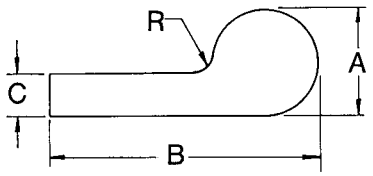
MOLD NO.	A	B	C	D	E	F	R
3000A & OPP.	1¾	6**	9/16	½*	19¼	***	⅜R
6047 & 6048	1¾	5	9/16	—	12	12	5/16R
4602 & OPP.	2¾	7**	1	1¼*	***	***	5/16R

***AS REQUIRED **MAX. *MIN.



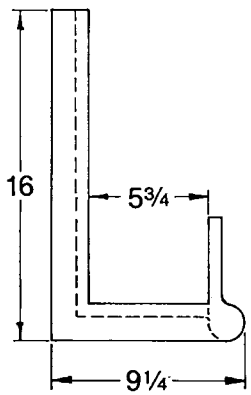


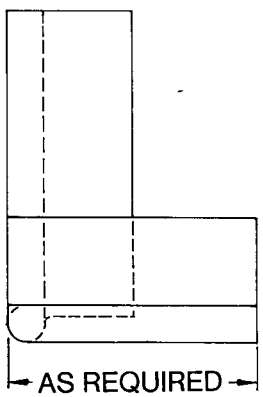




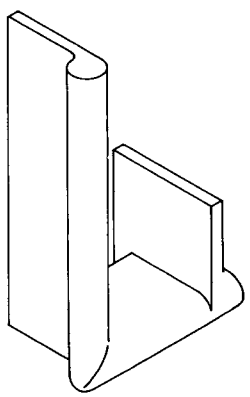
MOLD NO.	A	B	C	D	E	F	R
6262 & 6263	2	6	1	8	15	15	5/16R
4344 & 4345	1¾	5**	9/16	6¼*	16	16	5/16R
4172-A & OPP.	2¾	6	1	11⅛*	14½	***	5/16R
6198 OBT & OPP.	1	4½**	½	***	***	15**	7/16R

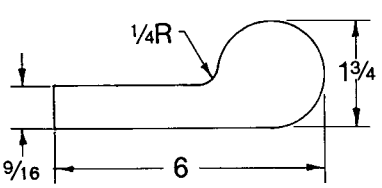
***AS REQUIRED **MAX. *MIN.





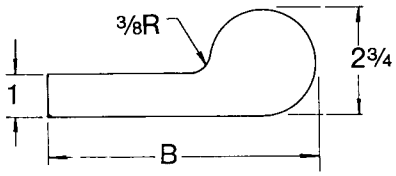
MOLD NO. 6848 & 6849
AS SHOWN AND OPPOSITE

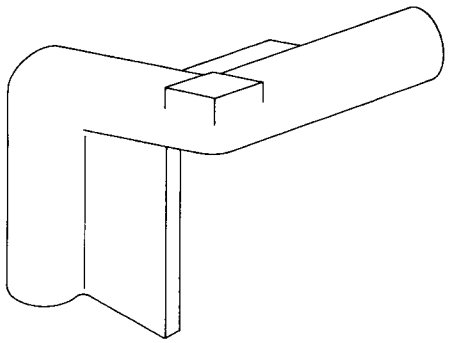


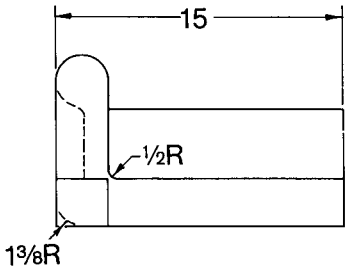


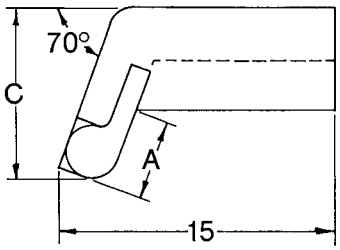
TYPICAL CROSS SECTION

A-8

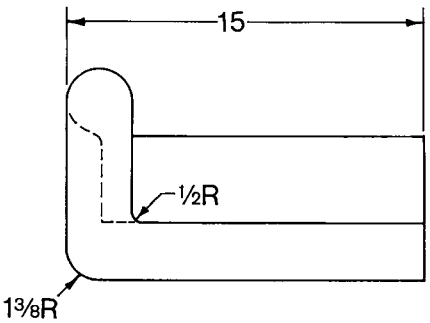




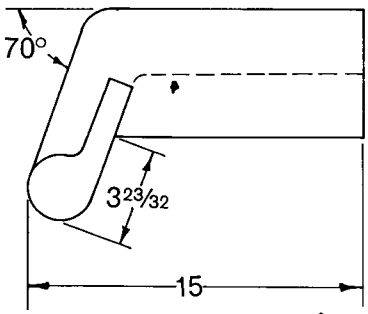


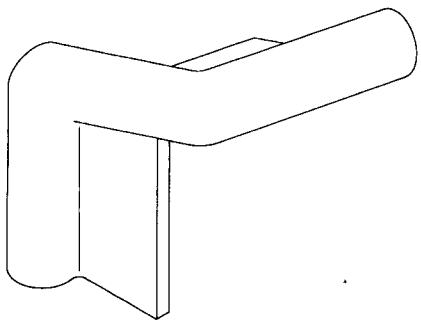


MOLD NO.	A	B	C
4727 & 4728	2 1/4	7	8 3/4
4442A & 4443A	3 23/32	6	9 1/8

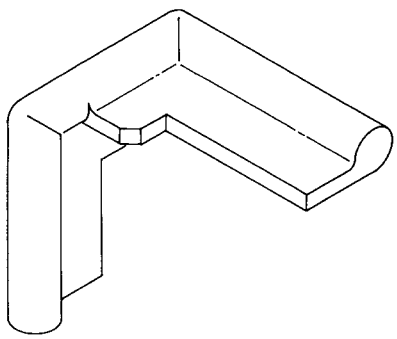


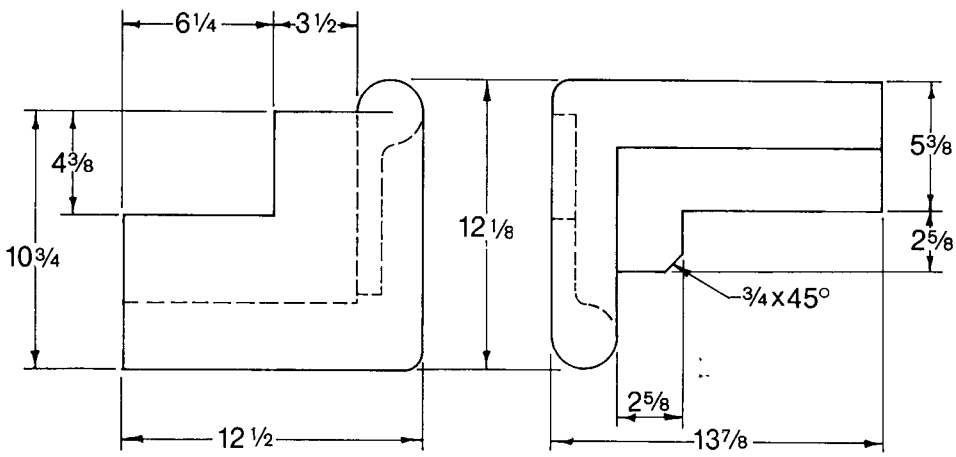
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2950
6" MAX. WIDTH

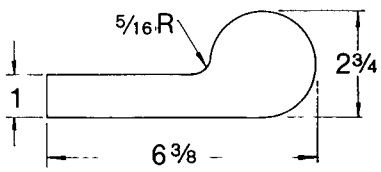




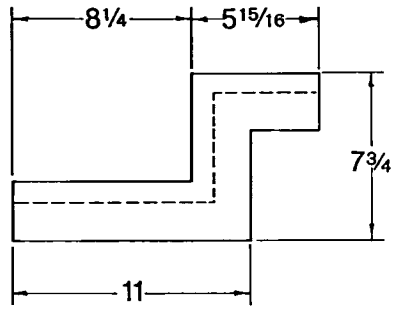
MOLD NO. 4442 & 4443

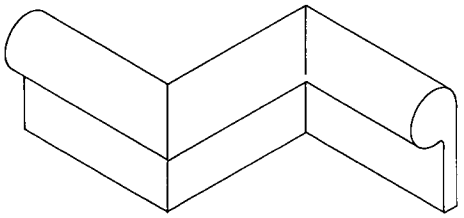






MOLD NO. 3844 & 3845
AS SHOWN AND OPPOSITE



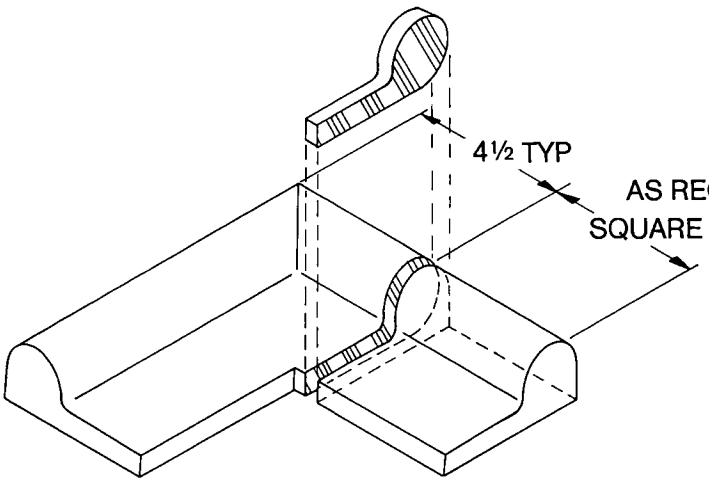


MOLD NO. 4315 & 4316

AS SHOWN AND OPPOSITE

TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2950

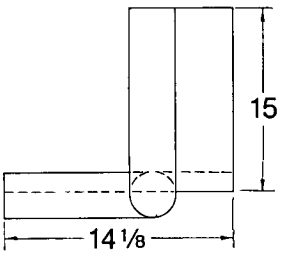
5″ MAX. WIDTH

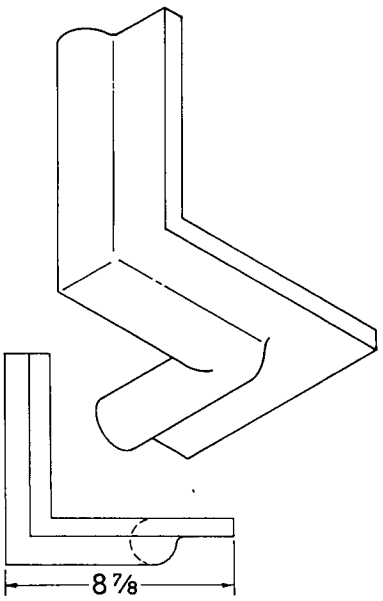


MOLD NO. 6346

AS SHOWN AND OPPOSITE

TRANSITION LINE ABRUPT ROUND BULB TO SQUARE CORNER BULB, TYP



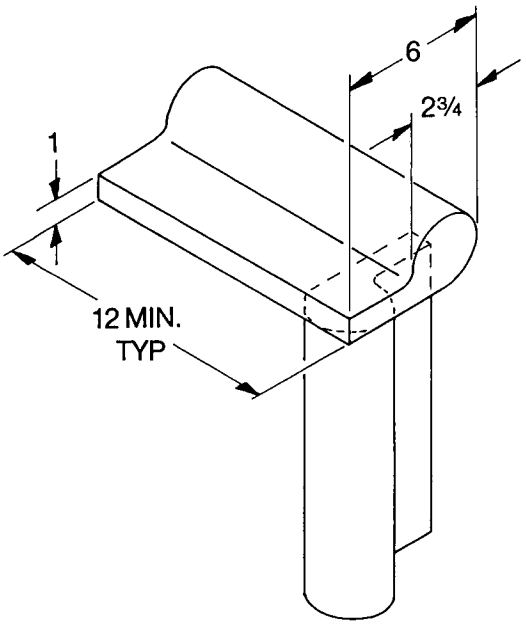


MOLD NO. 3085 & 3086

AS SHOWN AND OPPOSITE

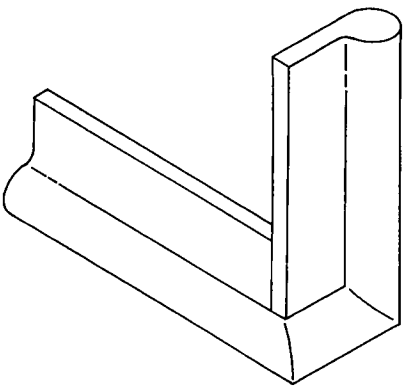
TYPICAL BULB CROSS SECTION
PAGE A-1 MOLD NO. 2514

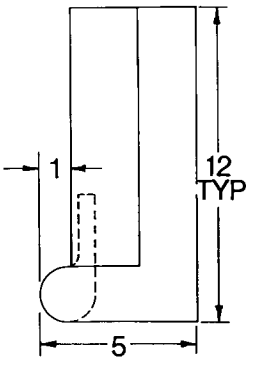
5″ MAX. WIDTH



MOLD NO. 5118 & 5119

AS SHOWN AND OPPOSITE





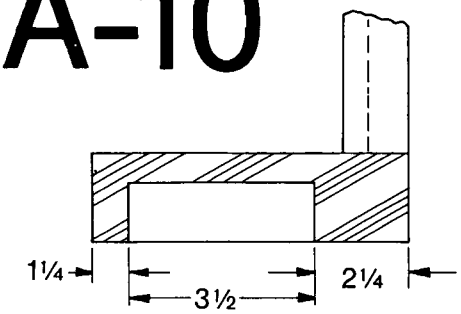
MOLD NO. 5948 & 5949

AS SHOWN AND OPPOSITE

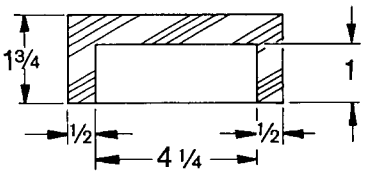
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514

4″ MAX. WIDTH

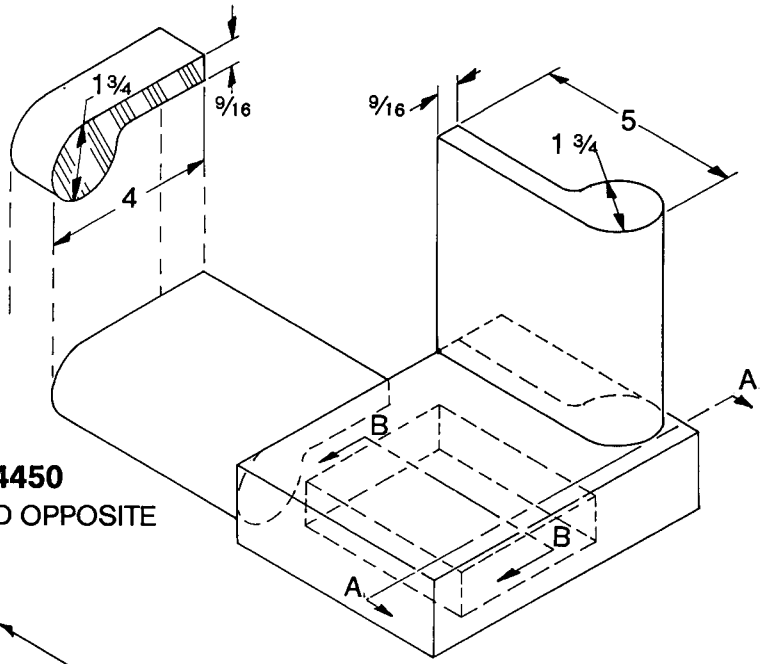
A-10



SECTION A-A



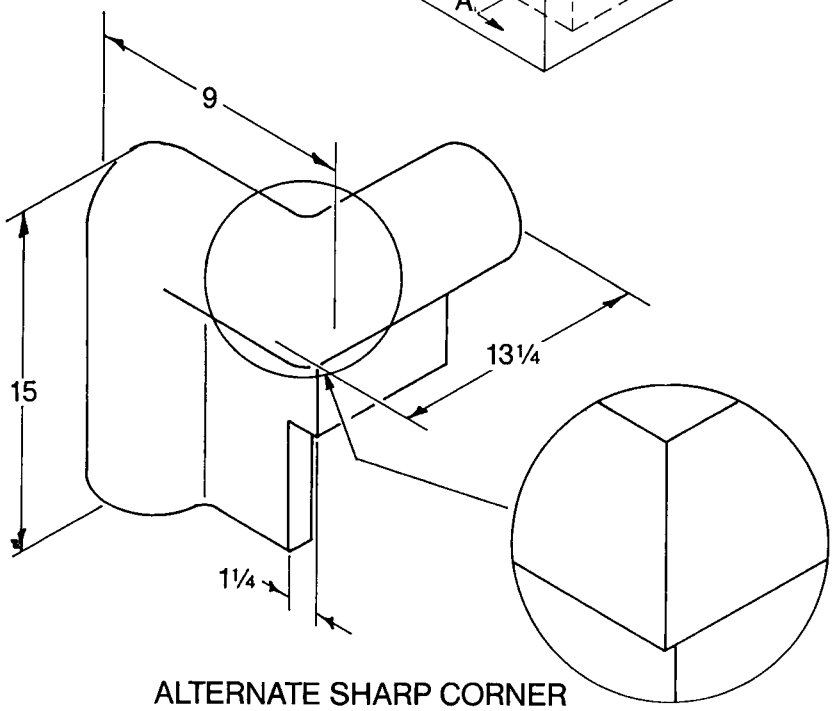
SECTION B-B



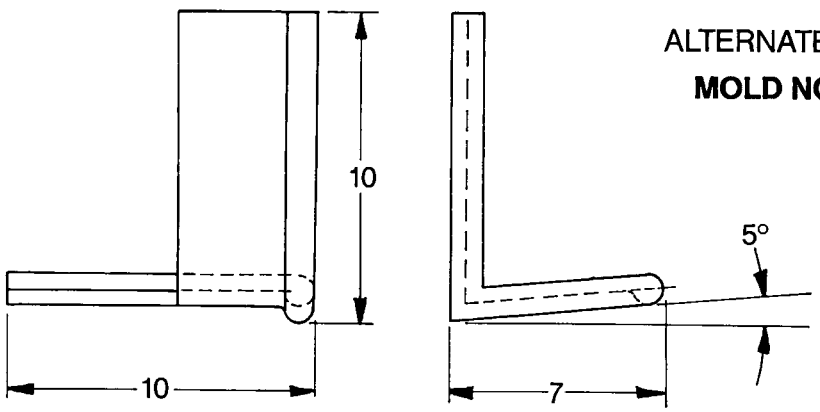
MOLD NO. 4450
AS SHOWN AND OPPOSITE

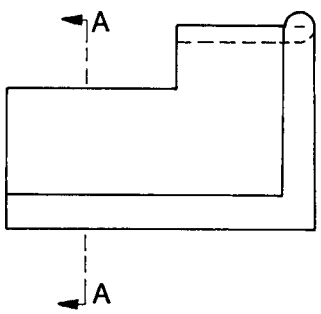
MOLD NO. 3032 & 3033
AS SHOWN AND OPPOSITE
TRANSITION SEALS FOR CULVERT VALVE

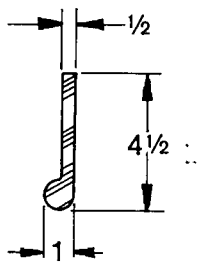
TYPICAL BULB CROSS SECTION
PAGE A-1 MOLD NO. 2950



ALTERNATE SHARP CORNER
MOLD NO. 3032A & 3033A

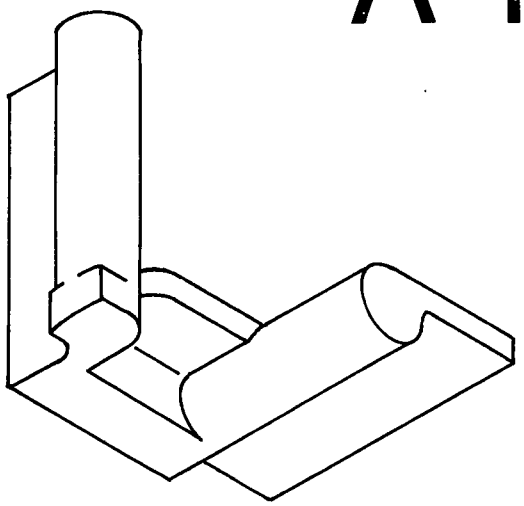


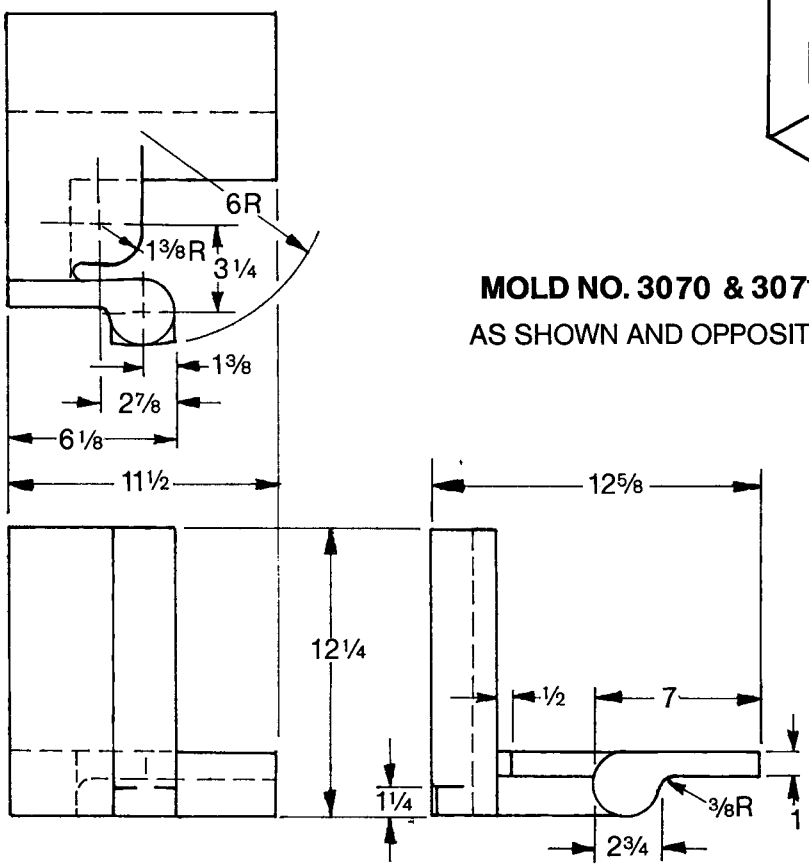




SECTION A-A

MOLD NO. 5345 & 5346
AS SHOWN AND OPPOSITE

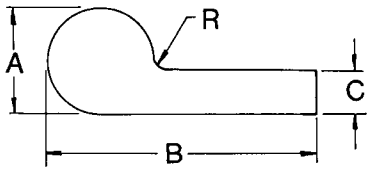


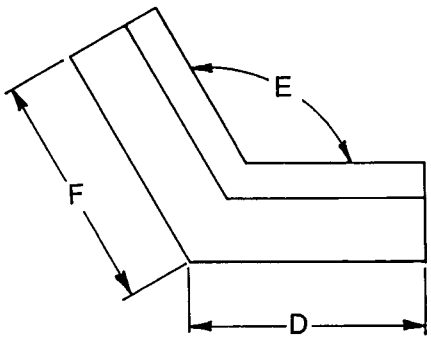


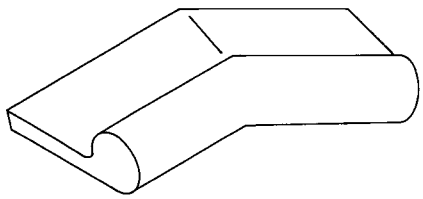
MOLD NO. 3070 & 3071

AS SHOWN AND OPPOSITE

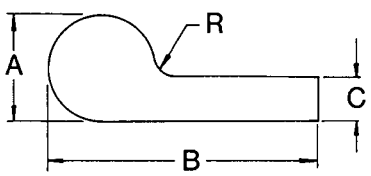
B-1

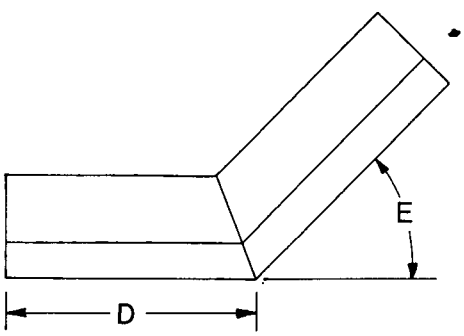


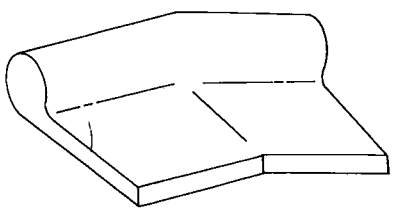




MOLD NO.	A	B	C	D	E	F	R
4175 & 4176	1¾	4	9/16	11 13½	135°	13½ 11	5/16
5618	2½	6	7/8	19	127°	19	3/8
5620	2½	6	7/8	18	111°	18	3/8
6046	1¾	5	9/16	12	120°	12	5/16





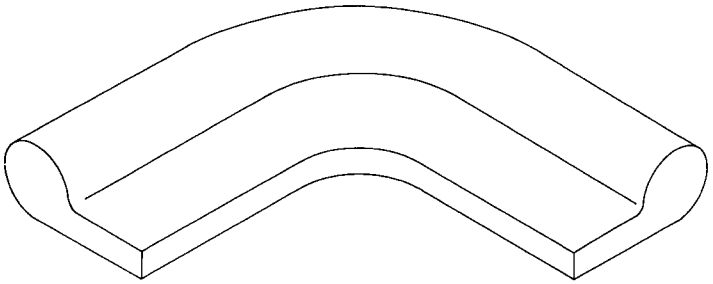


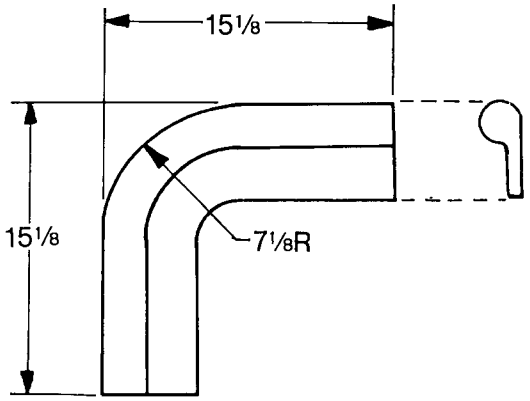
MOLD NO.	A	B	C	D	E	R
4171	2¾	6	1	*** TYP	61°	3/8R
5617	2½	6	7/8	22 TYP	53°	3/8R
5619	2½	6	7/8	21 TYP	69°	3/8R
4796	2¾	6	1	15 TYP	45°	3/8R
5032	2¾	9¼	1	18 TYP	45°	3/8R

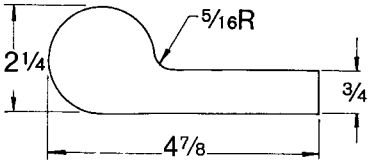
*** AS REQUIRED

B-2

MOLD NO. 3542

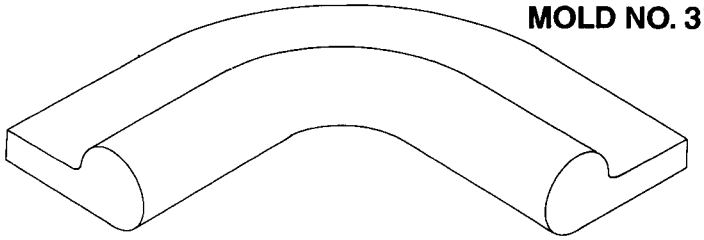


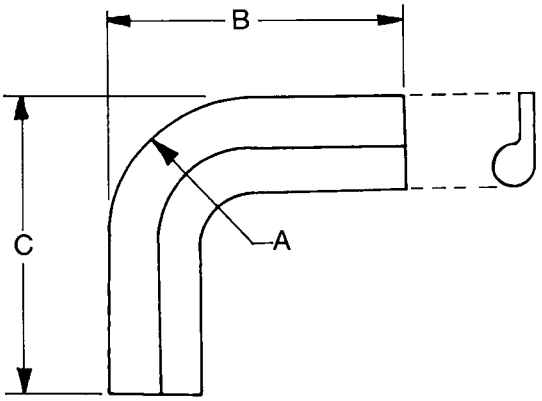




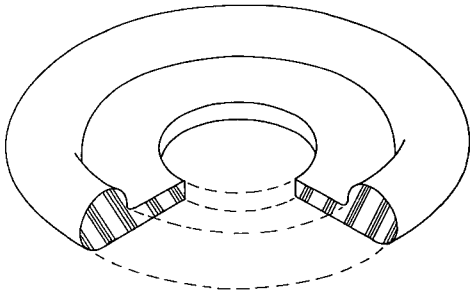
TYPICAL CROSS SECTION

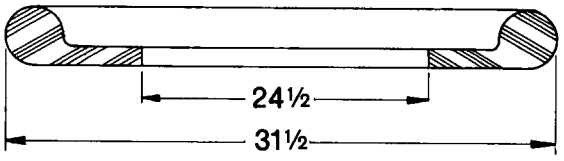
MOLD NO. 3541
MOLD NO. 3706



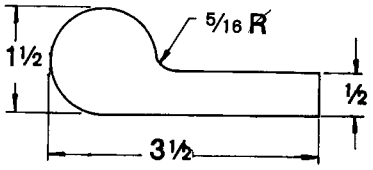


MOLD NO.	A	B	C
3541	7⅜R	15½	15½
3706	10 7/16R	21	21

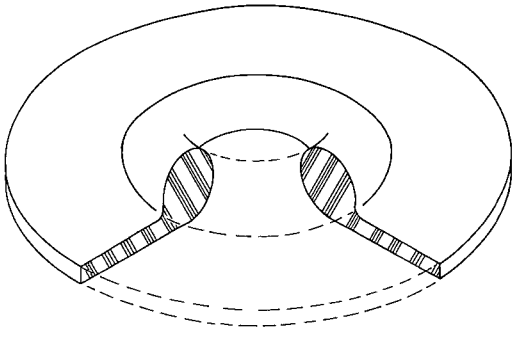




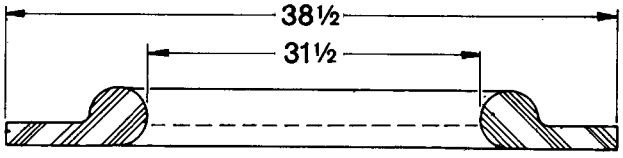
MOLD NO. 5739



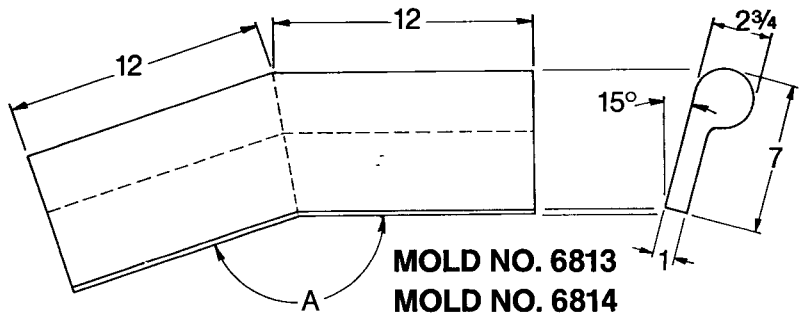
TYPICAL CROSS SECTION



MOLD NO. 5738

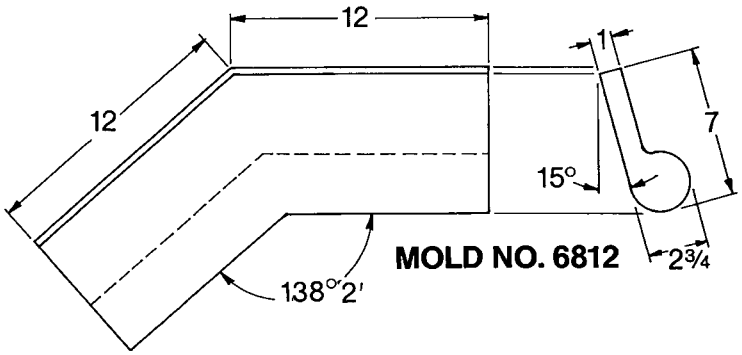


B-3

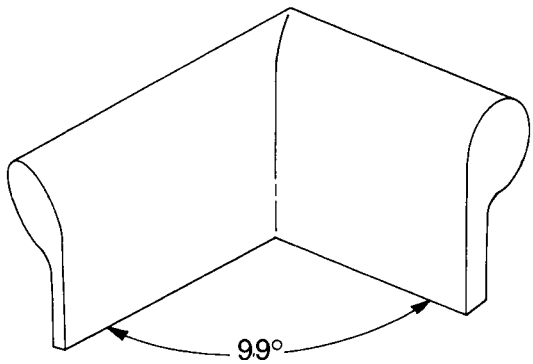


MOLD NO. 6813
MOLD NO. 6814

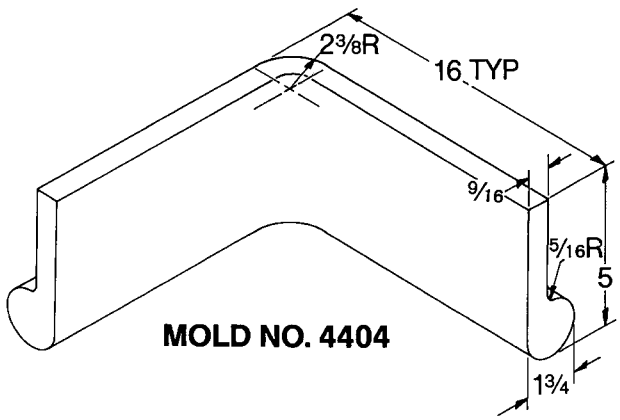
MOLD NO.	A
6813	138°26′
6814	161°34′



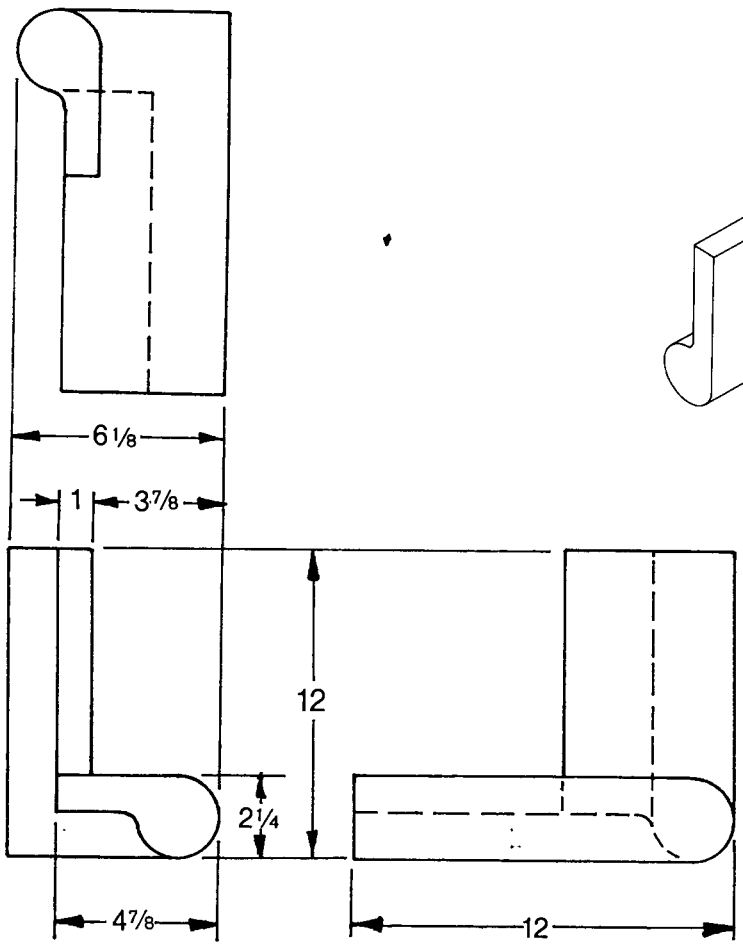
MOLD NO. 6812



MOLD NO. 4604
BULB CROSS SECTION SAME AS 4404 BELOW

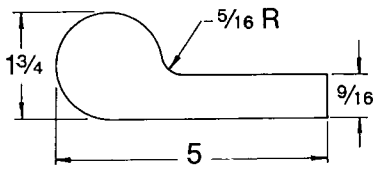


MOLD NO. 4404



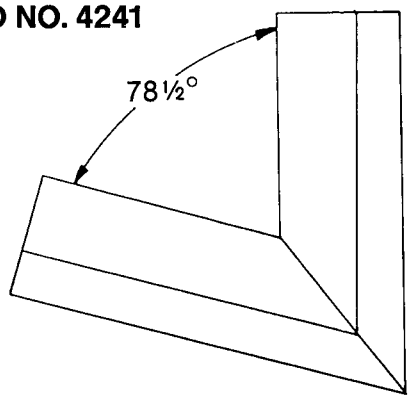
MOLD NO. 7047 & 7048

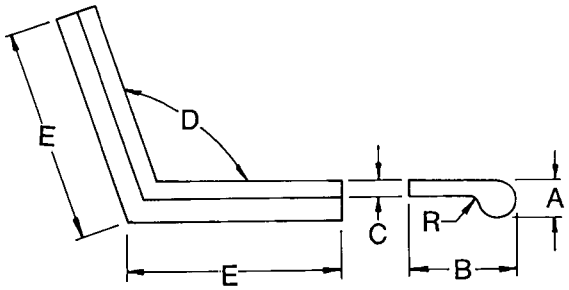
B-4



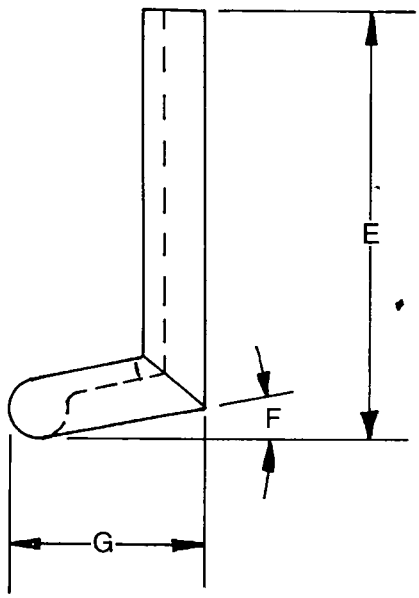
TYPICAL CROSS SECTION

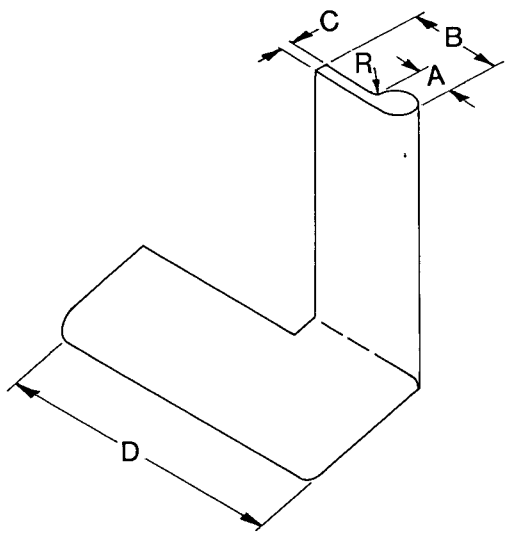
MOLD NO. 4241





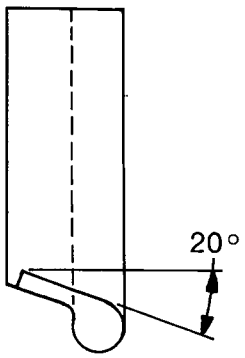
MOLD NO.	A	B	C	D	E	R
4935	2¼	6	1	108°30′	12	¼R
5497& OPP.	1¾	5	9/16	112½°	15	5/16R

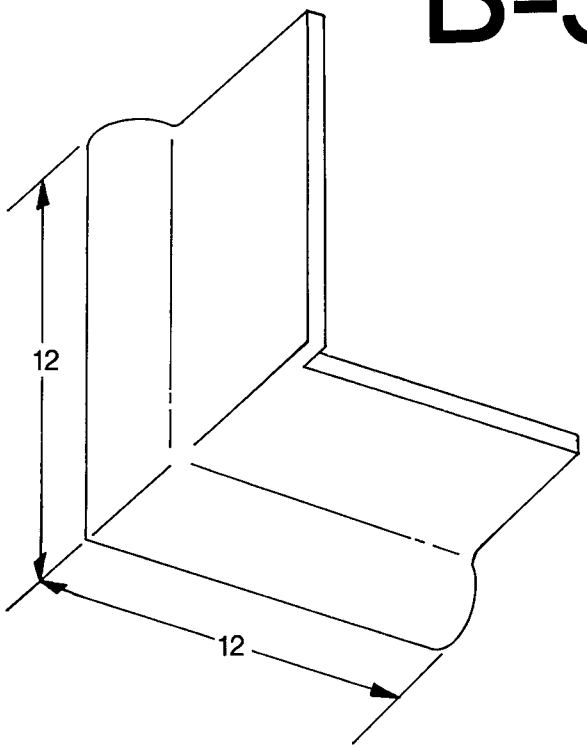




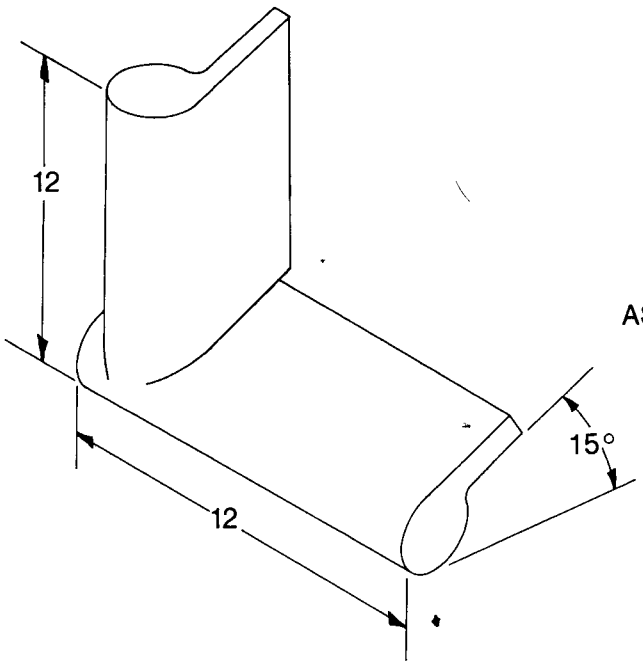
MOLD NO.	A	B	C	D	E	F	G	R
5453 & 5454	1¾	4	9/16	12	12	9°	5 11/16	5/16R
5114 & 5115	1¾	5	9/16	15	15	11°	6 15/16	5/16R
6473 & 6474	1¾	5	9/16	12*	12*	23°38′	7¾	5/16R
6102 & OPP.	2½	6	⅞	14	12	45°	9⅞	⅜R
4936**	2¼	6	1	15	11⅜	18½°	10½	¼R

*MIN. **AS SHOWN ONLY





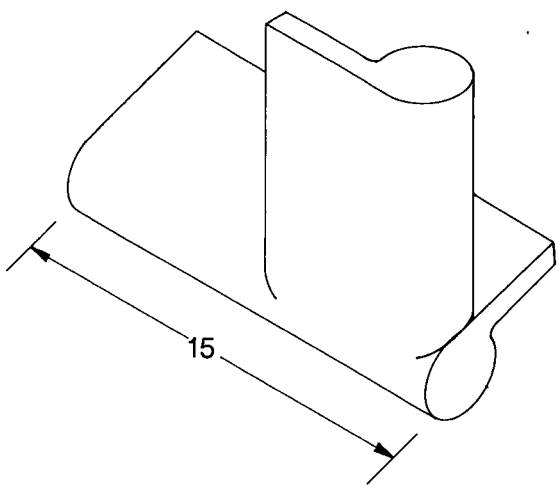
MOLD NO. 5955 & 5956
AS SHOWN AND OPPOSITE
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514
4" MAX. WIDTH



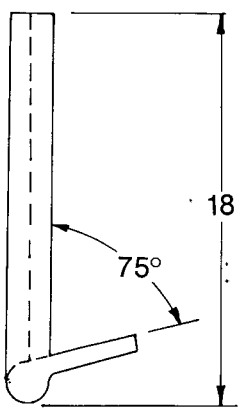
MOLD NO. 2773-1
AS SHOWN AND OPPOSITE

TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514
4" MAX. WIDTH

MOLD NO. 4942
AS SHOWN AND OPPOSITE



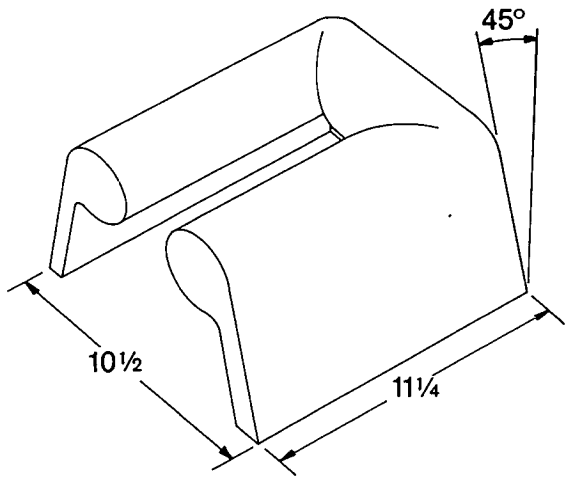
SOFT RUBBER CORE
½" DIA., OPTIONAL

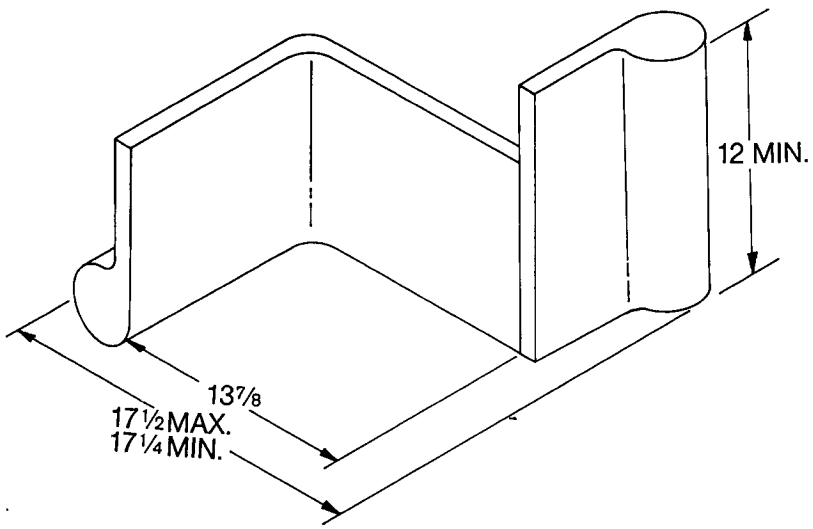


TYPICAL CROSS SECTION
PG. A1, MOLD NO. 3762
5" MAX. WIDTH

B-6

MOLD NO. 4485 & 4486
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514
5″ MAX. WIDTH



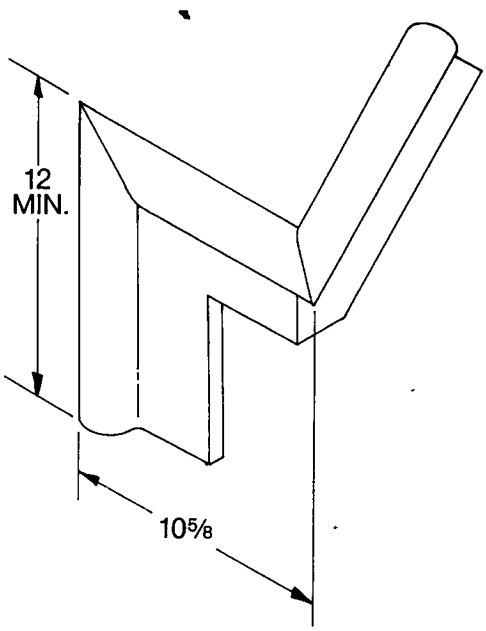


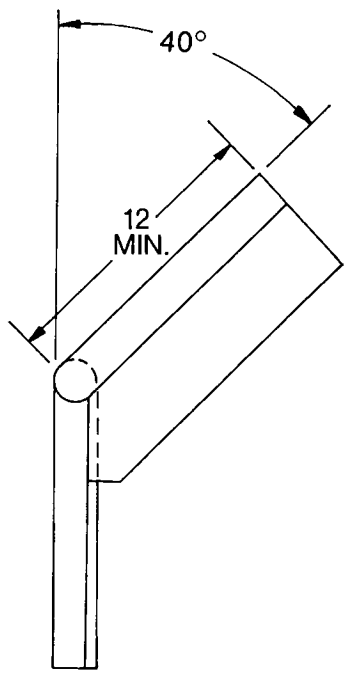
MOLD NO. 6349 & 6350
AS SHOWN AND OPPOSITE

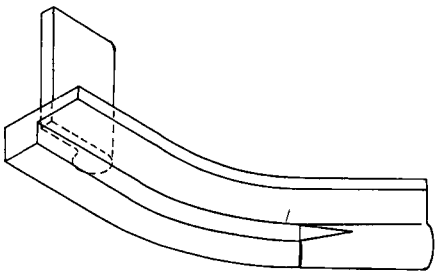
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514
4″ MAX. WIDTH

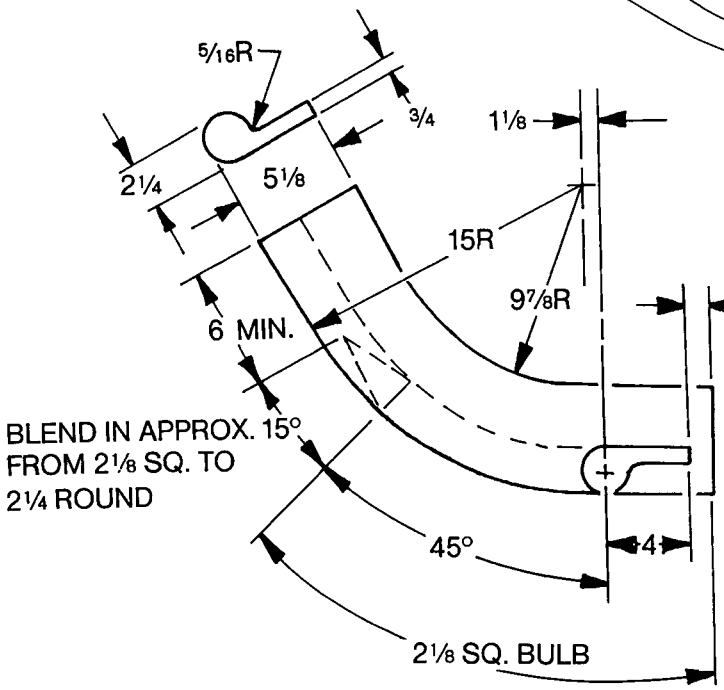
MOLD NO. 5129 & 5130
AS SHOWN AND OPPOSITE

TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514
5 ″ MAX. WIDTH

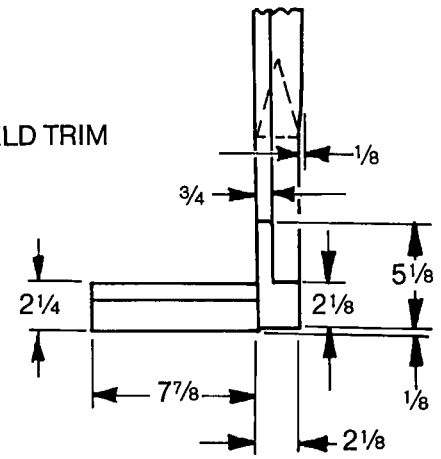


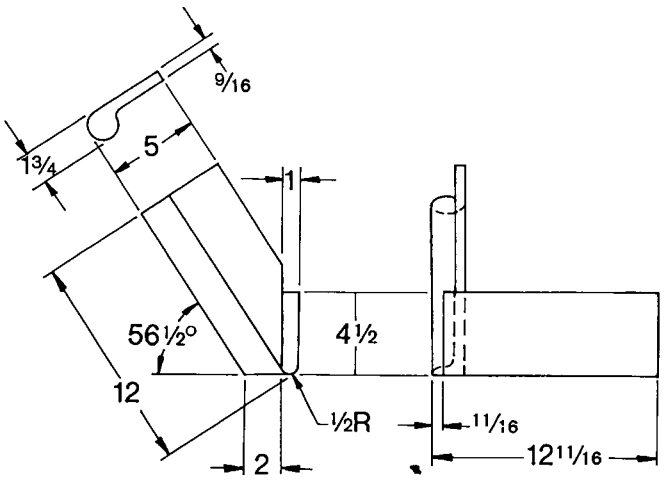


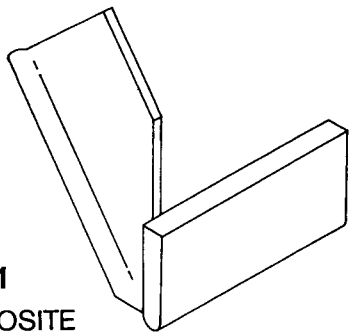




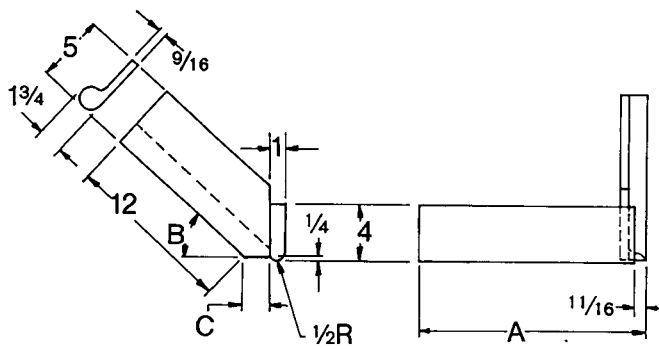
MOLD NO. 5874 & 5875
AS SHOWN AND OPPOSITE

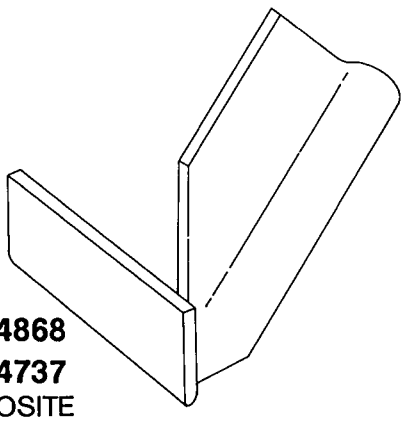






MOLD NO. 5801
AS SHOWN AND OPPOSITE

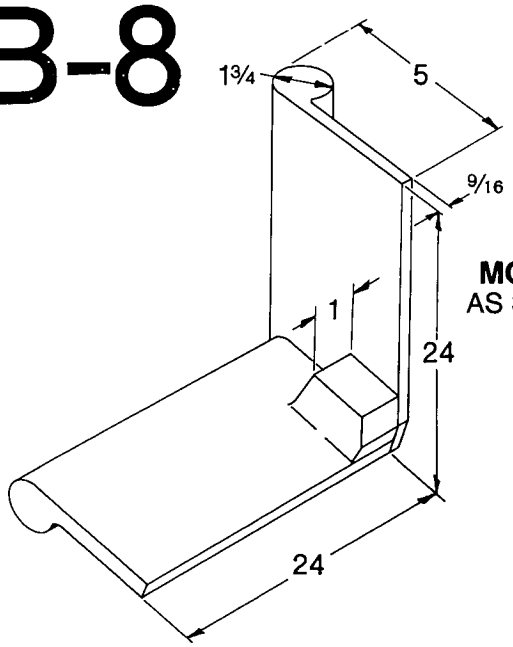




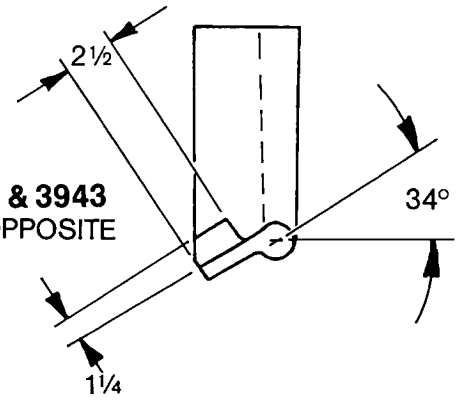
MOLD NO. 4867 & 4868
MOLD NO. 4736 & 4737
AS SHOWN AND OPPOSITE

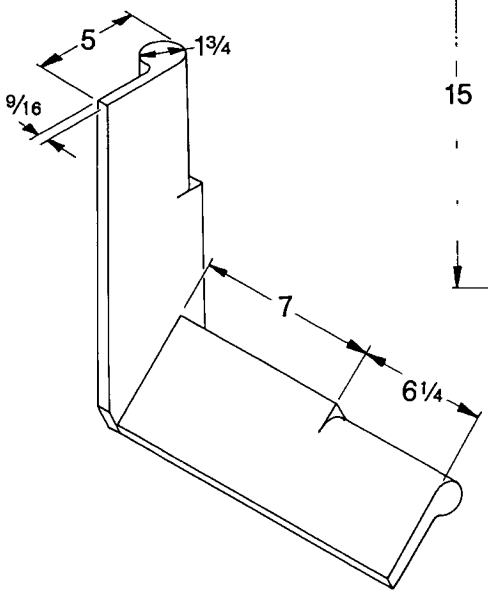
MOLD NO.	A	B	C
4867 & 4868	16	42°	1 7/8
4736 & 4737	12	34 1/2°	1 3/8

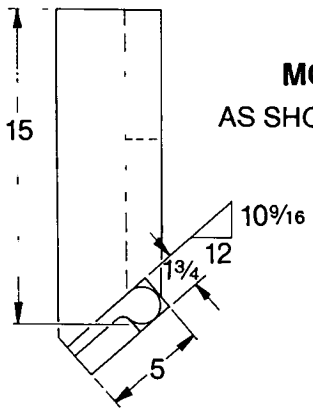
B-8



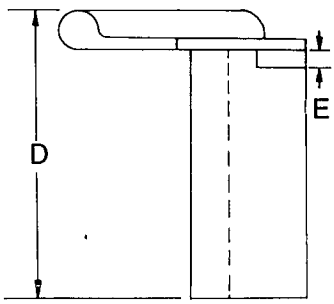
MOLD NO. 3942 & 3943
AS SHOWN AND OPPOSITE

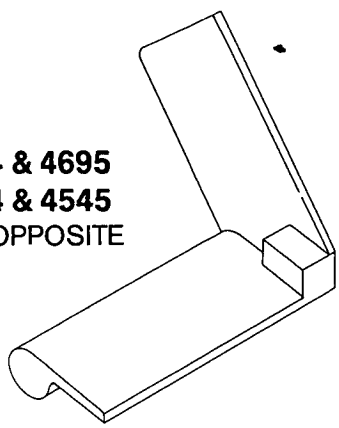




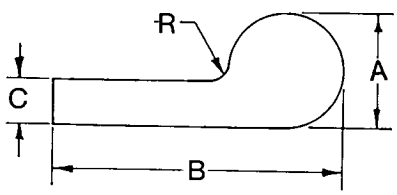


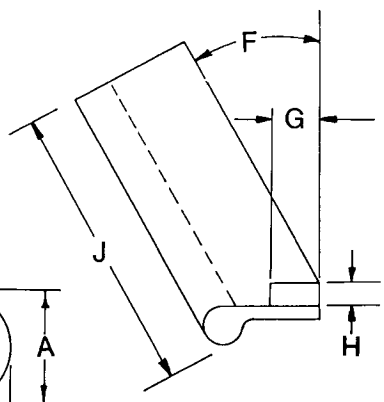
MOLD NO. 4084
AS SHOWN AND OPPOSITE





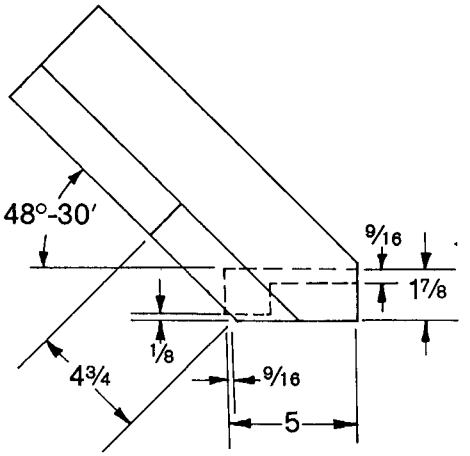
MOLD NO. 4694 & 4695
MOLD NO. 4544 & 4545
AS SHOWN AND OPPOSITE

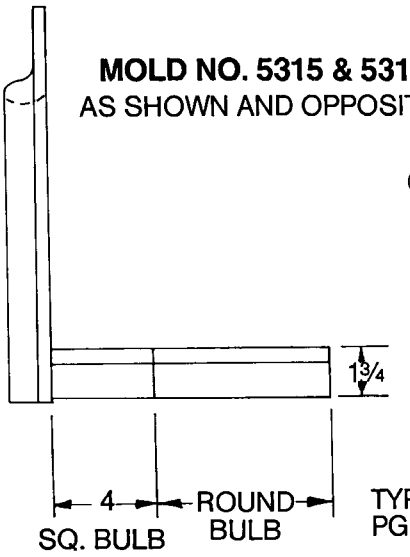


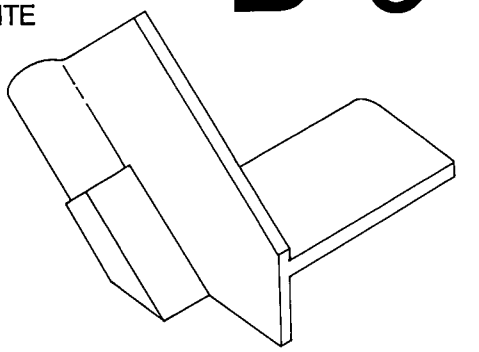


MOLD NO.	A	B	C	D	E	F	G	H	J	R
4694 & 4695	2¼	6	¾	15	½	59°	2¾	1⅜	15	5/16R
4544 & 4545	1¾	5	9/16	15	⅞	53°	2½	1¼	15	5/16R

MOLD NO. 5315 & 5316
AS SHOWN AND OPPOSITE

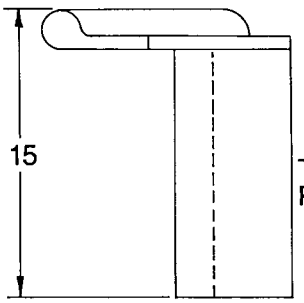






TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514

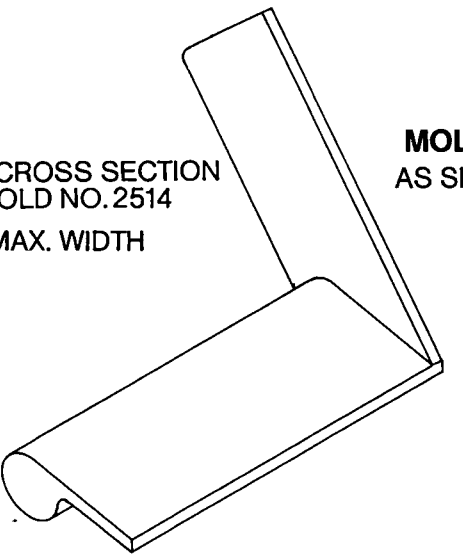
5″ MAX. WIDTH

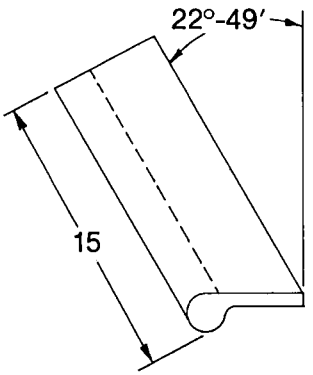


TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514

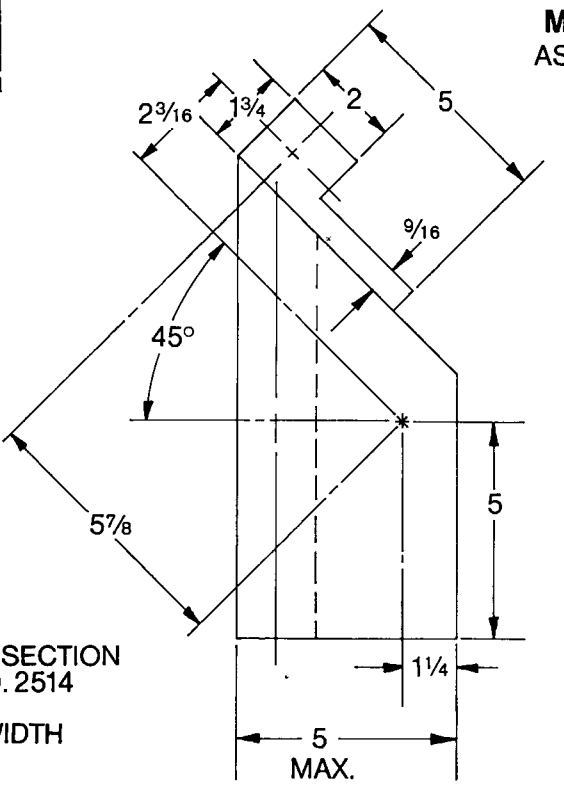
6″ MAX. WIDTH

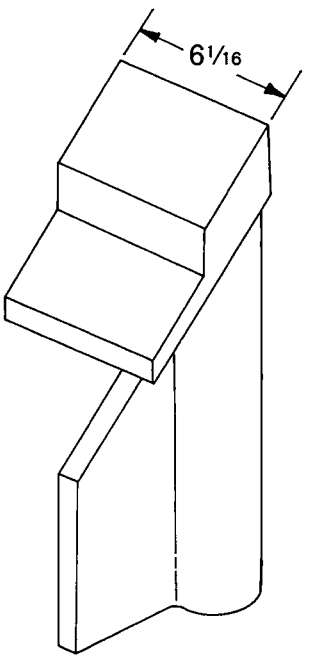
MOLD NO. 4592 & 4593
AS SHOWN AND OPPOSITE





MOLD NO. 5399 & 5400
AS SHOWN AND OPPOSITE





TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514

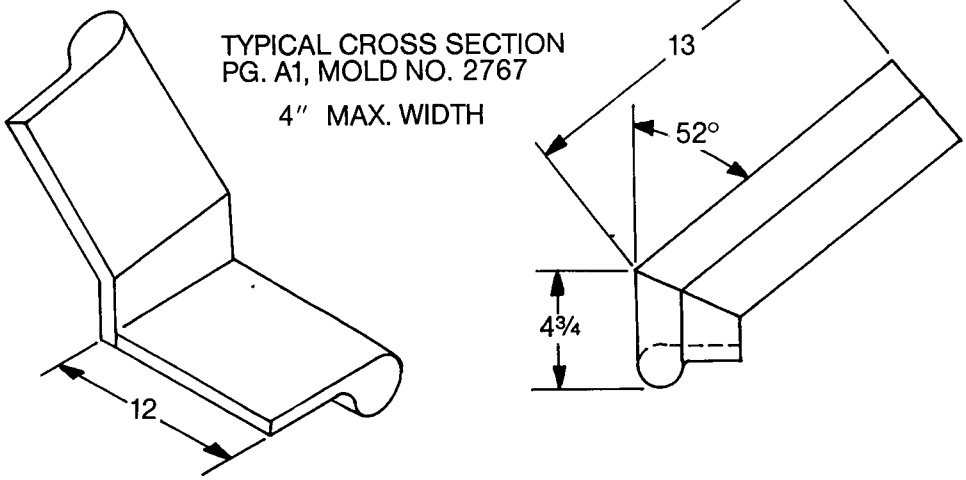
5″ MAX. WIDTH

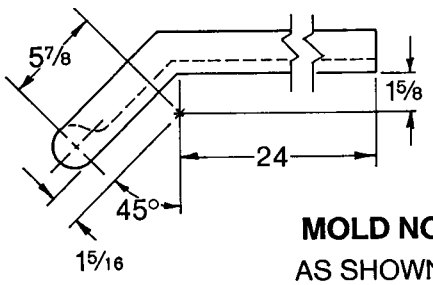
B-10

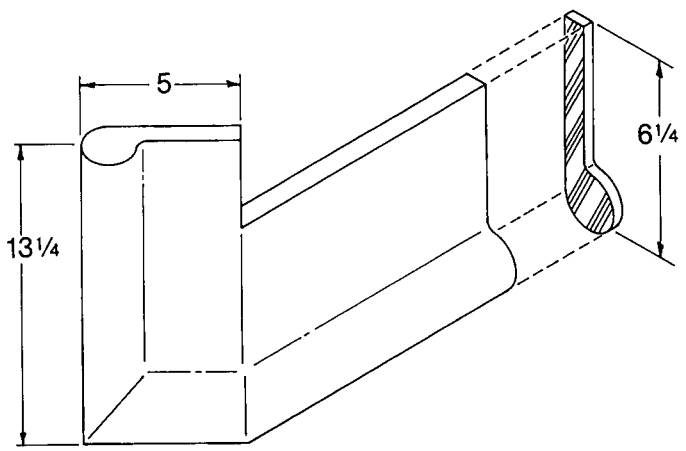
MOLD NO. 6044 & 6045
AS SHOWN AND OPPOSITE

TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2767

4" MAX. WIDTH

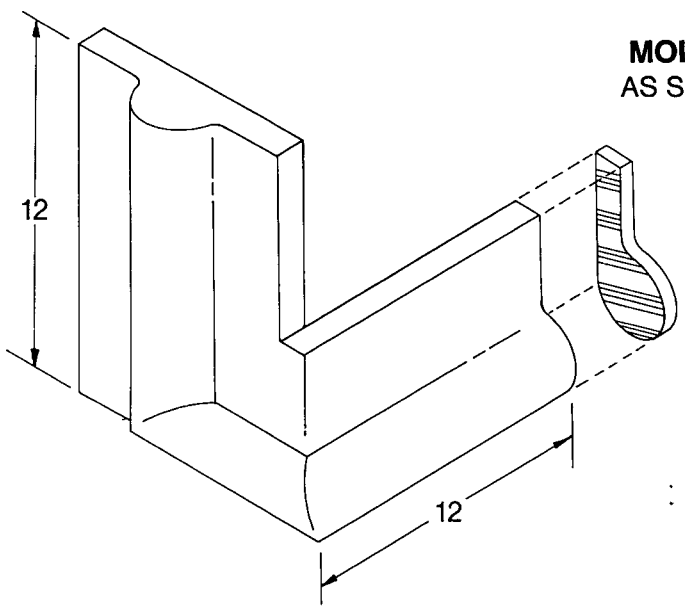






MOLD NO. 5389 & 5390
AS SHOWN AND OPPOSITE

TYPICAL BULB CROSS SECTION
PAGE A-1 MOLD NO. 2514



MOLD NO. 4862 & 4863
AS SHOWN AND OPPOSITE

TYPICAL 'J' SEAL CROSS SECTION PAGE A-1
MOLD NO. 2514 MAX. WIDTH 5"

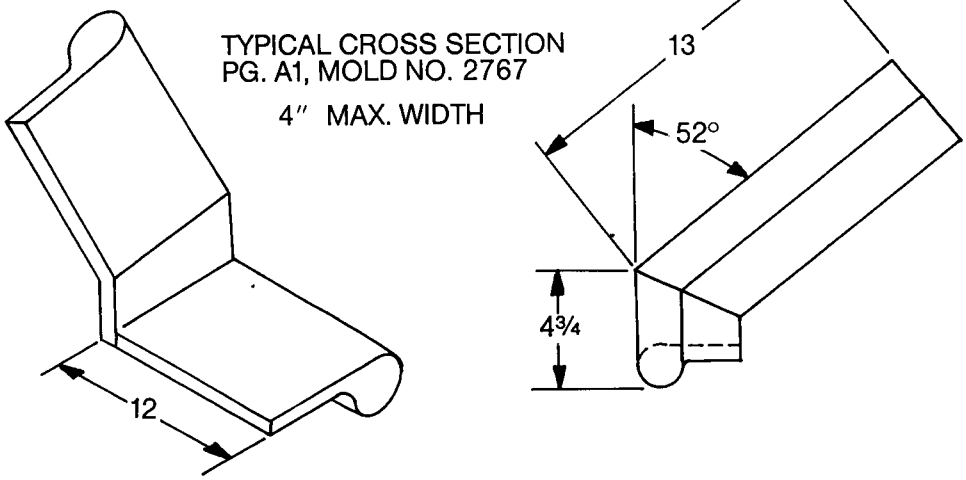
TYPICAL CENTER BULB CROSS SECTION
PAGE H6, MOLD NO. 4767 MAX. WIDTH 6¼"

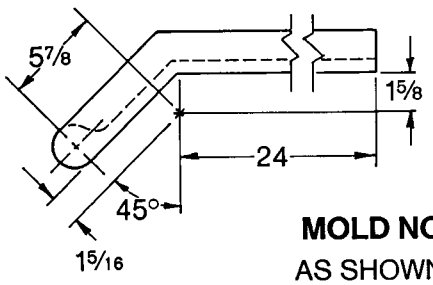
B-10

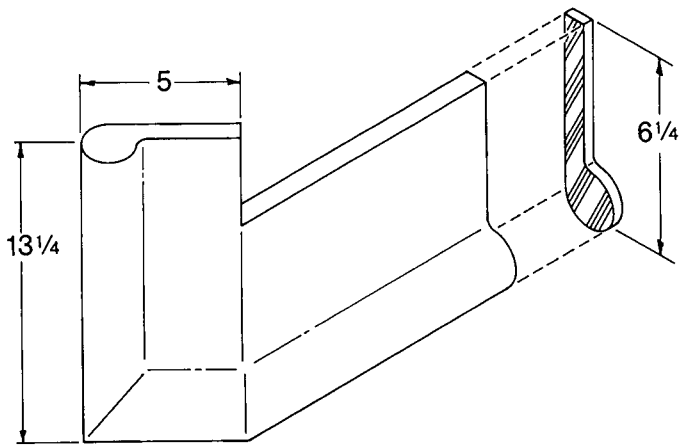
MOLD NO. 6044 & 6045
AS SHOWN AND OPPOSITE

TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2767

4" MAX. WIDTH

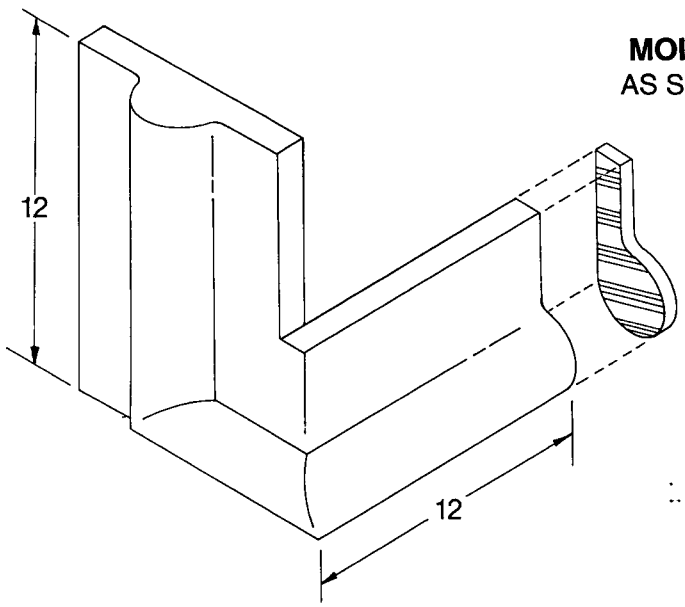






MOLD NO. 5389 & 5390
AS SHOWN AND OPPOSITE

TYPICAL BULB CROSS SECTION
PAGE A-1 MOLD NO. 2514

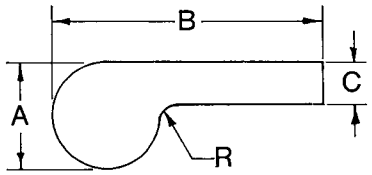


MOLD NO. 4862 & 4863
AS SHOWN AND OPPOSITE

TYPICAL 'J' SEAL CROSS SECTION PAGE A-1
MOLD NO. 2514 MAX. WIDTH 5"

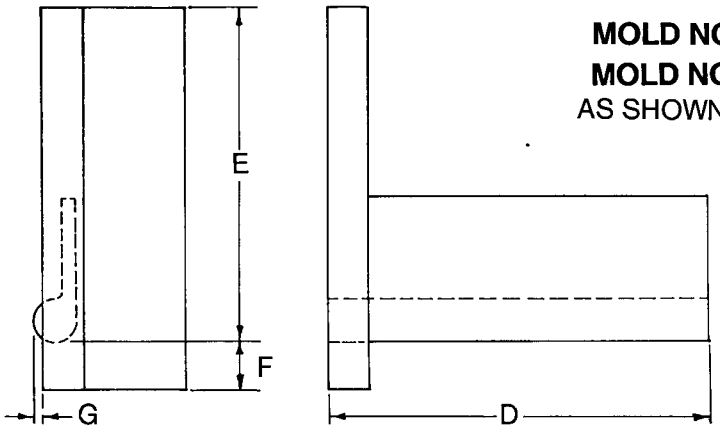
TYPICAL CENTER BULB CROSS SECTION
PAGE H6, MOLD NO. 4767 MAX. WIDTH 6¼"

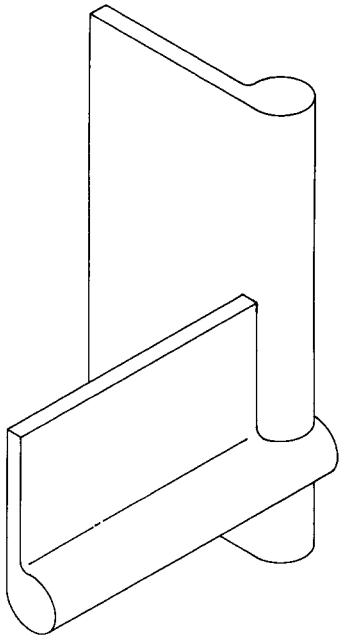
C-1



TYPICAL CROSS SECTION

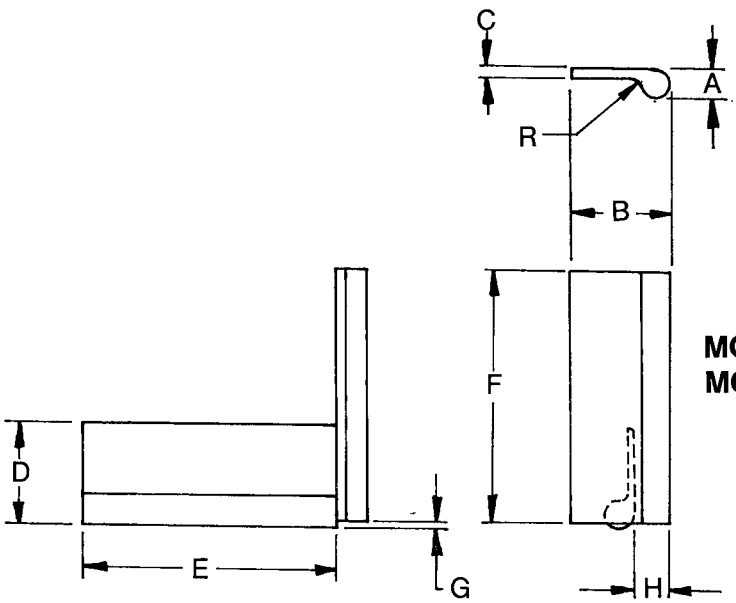
MOLD NO. 4686 & OPP.
MOLD NO. 4902 & 4903
AS SHOWN AND OPPOSITE



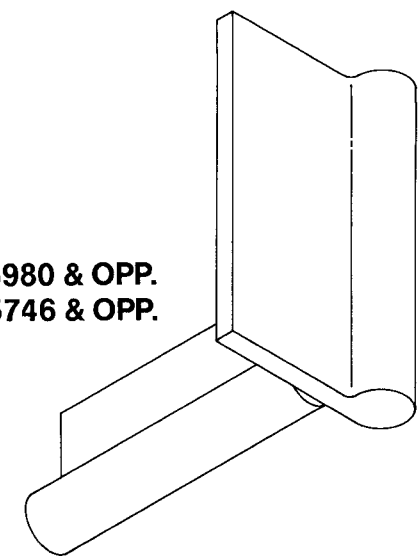


MOLD NO.	A	B	C	D	E	F	G	R
4686 & OPP.	1¾	6**	9/16	16	16	2	3/8	5/16R
4902 & 4903	1¾	5	7/8	12*	***	***	1/2	5/16R

*** AS REQUIRED **MAX. *MIN.



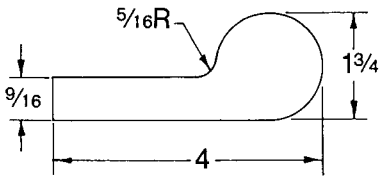
MOLD NO. 5980 & OPP.
MOLD NO. 5746 & OPP.



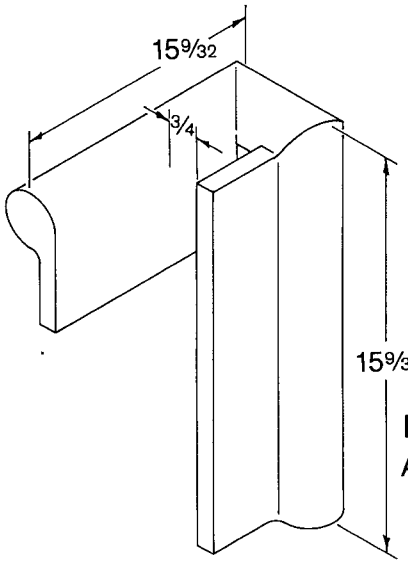
MOLD NO.	A	B	C	D	E	F	G	H	R
5980 & OPP.	1¾	6	9/16	6	15	15	1/4	1 13/16	5/16R
5746 & OPP.	1¾	6**	9/16	4½	***	***	1/4	1¾	5/16R

*** AS REQUIRED **MAX.

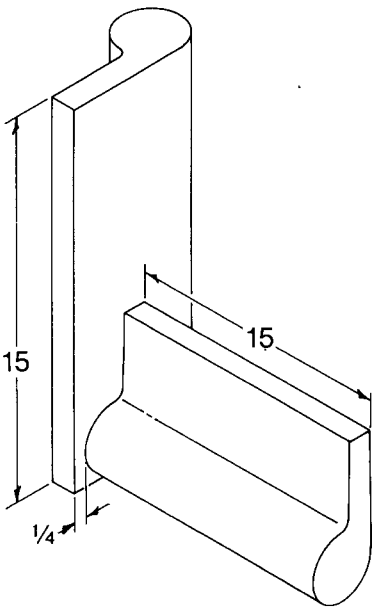
C-2



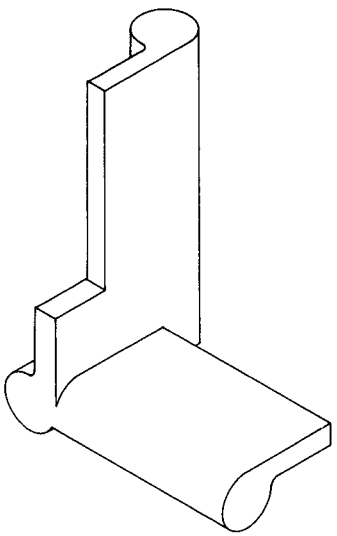
TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE

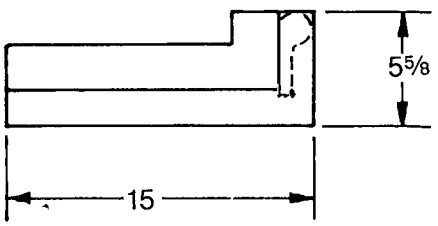


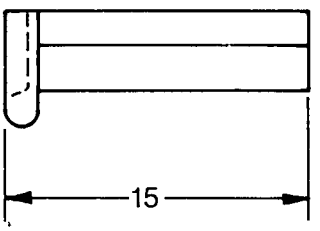
MOLD NO. 2685 & 2686
AS SHOWN AND OPPOSITE



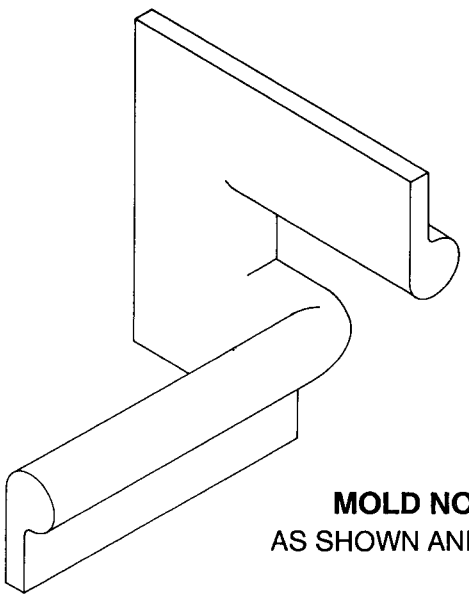
MOLD NO. 5556
AS SHOWN AND OPPOSITE

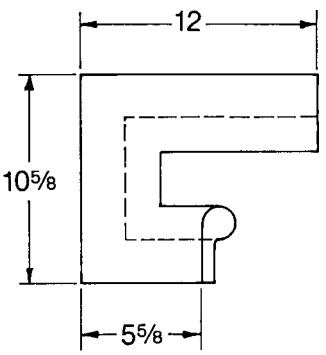


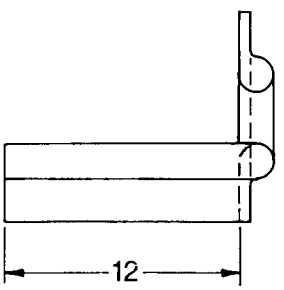




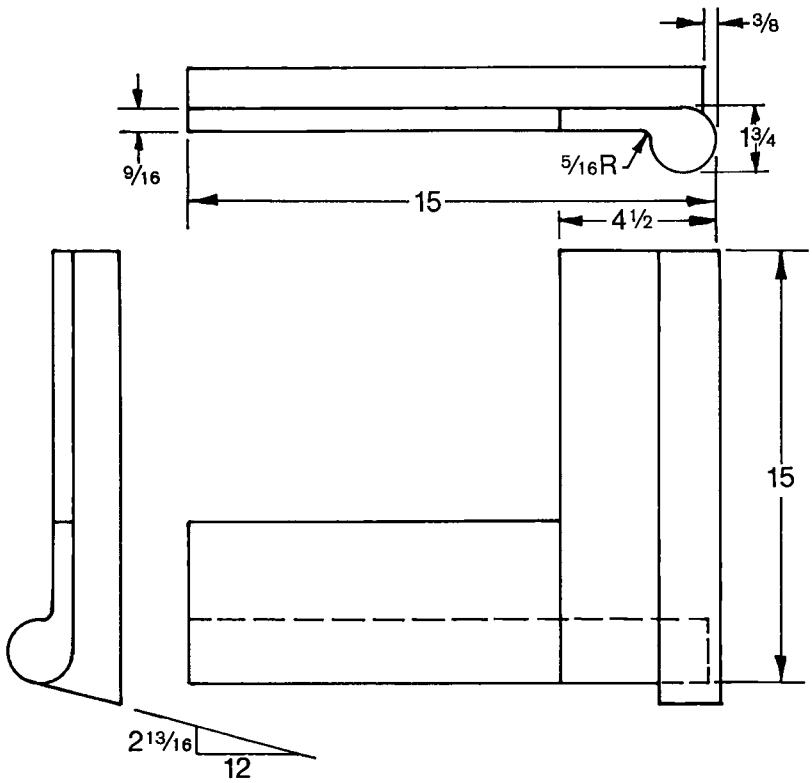
MOLD NO. 5116 & 5117
AS SHOWN AND OPPOSITE

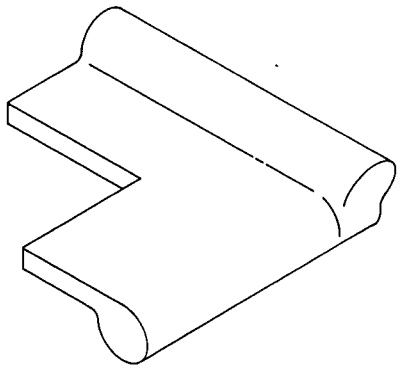




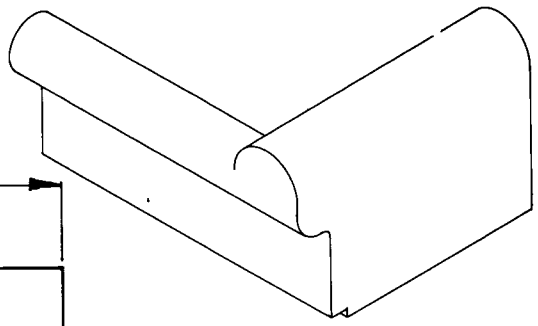


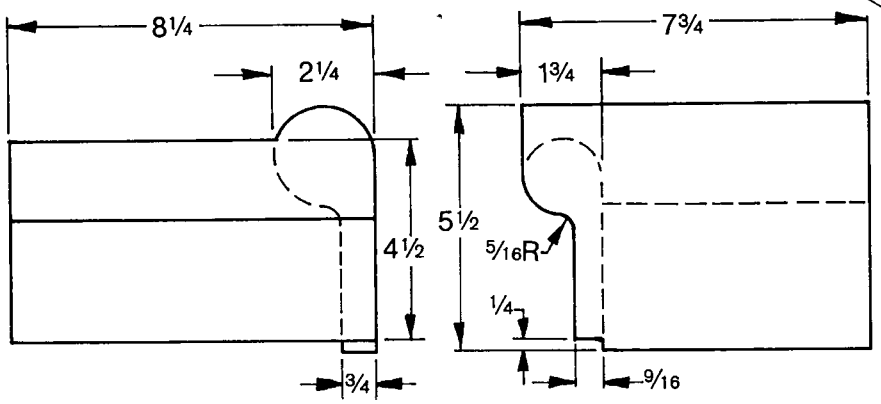
MOLD NO. 4703
AS SHOWN AND OPPOSITE



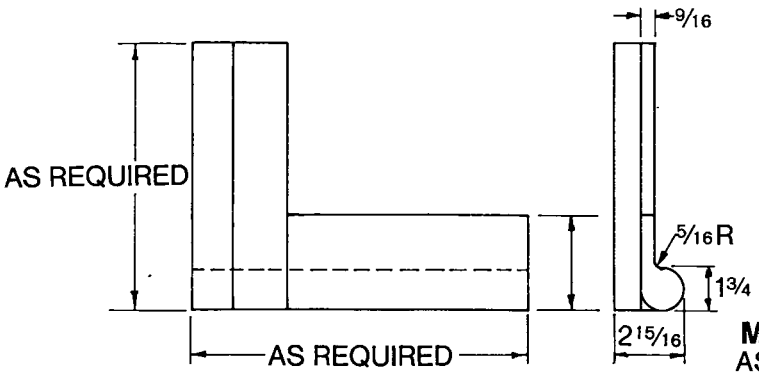


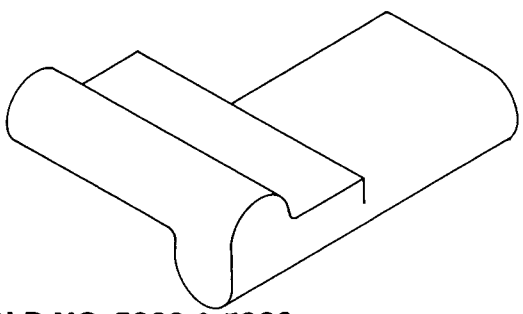
MOLD NO. 5600 & 5601
AS SHOWN AND OPPOSITE





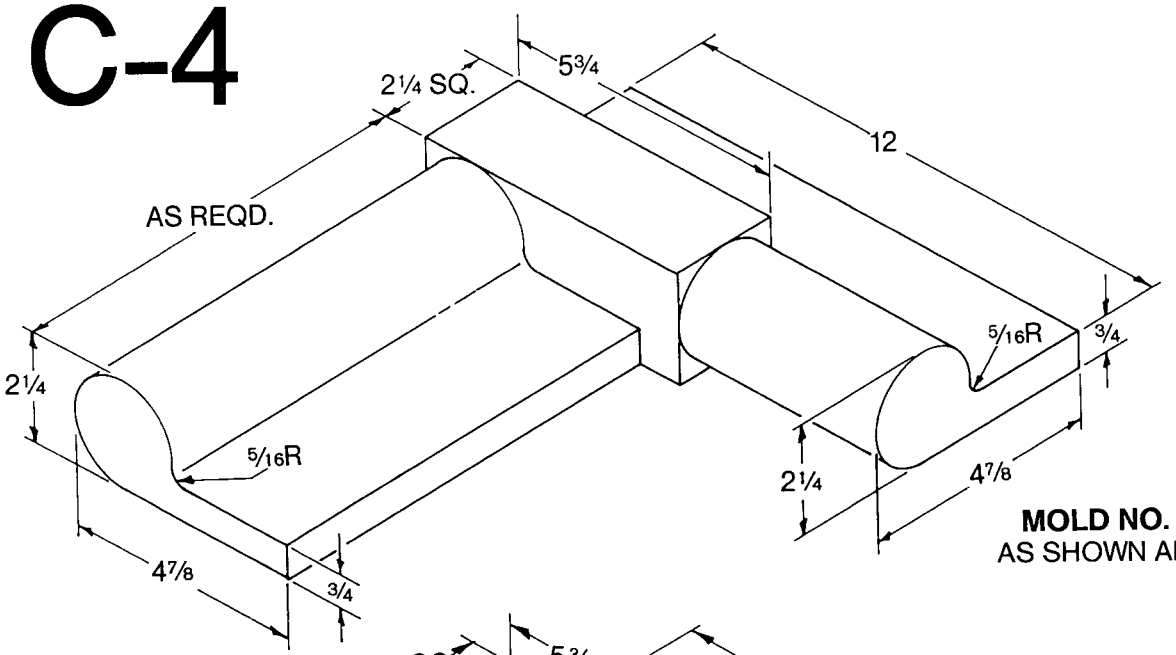
MOLD NO. 4810 & 4811
AS SHOWN AND OPPOSITE



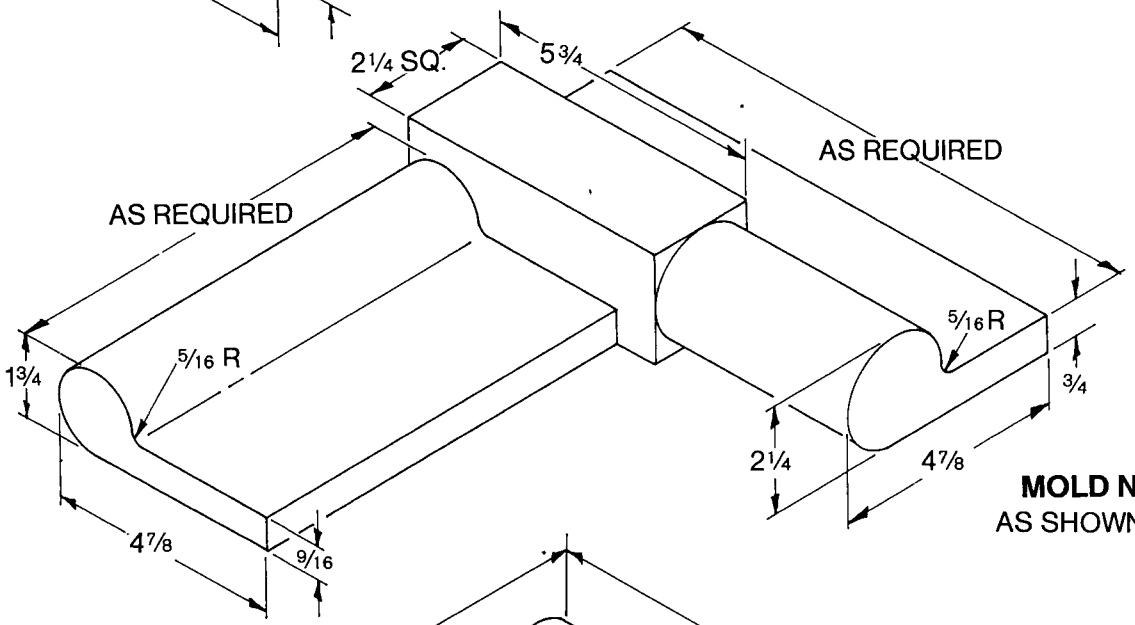


MOLD NO. 5323 & 5320
AS SHOWN AND OPPOSITE

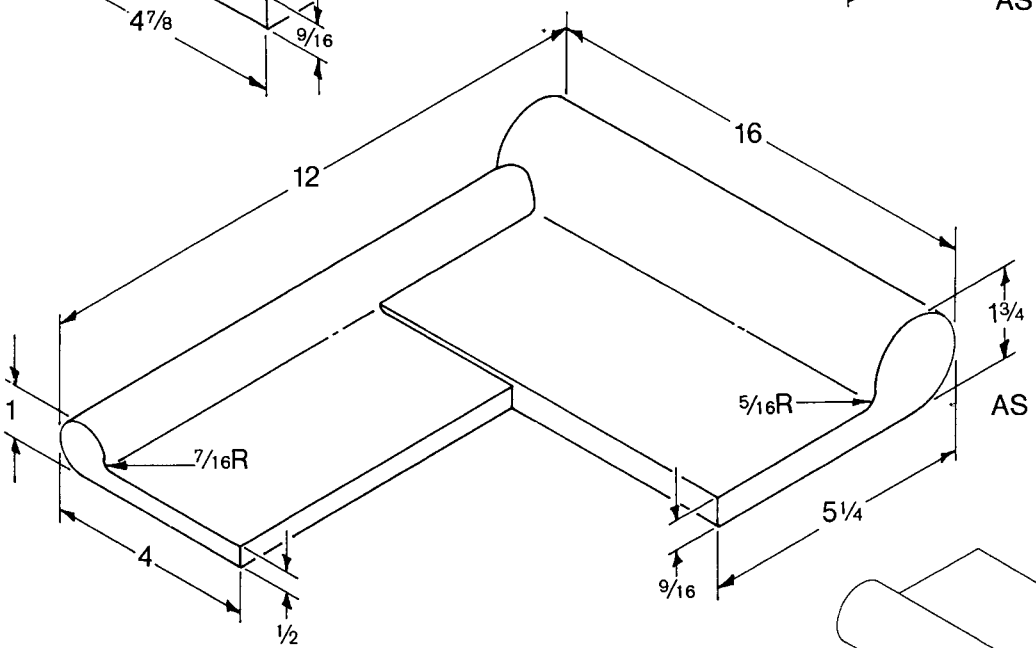
C-4



MOLD NO. 5958 & 5959
AS SHOWN AND OPPOSITE



MOLD NO. 6090 & 6091
AS SHOWN AND OPPOSITE



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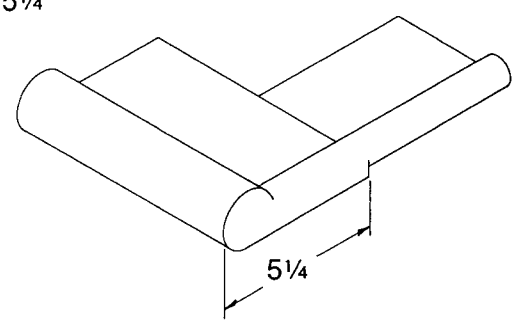
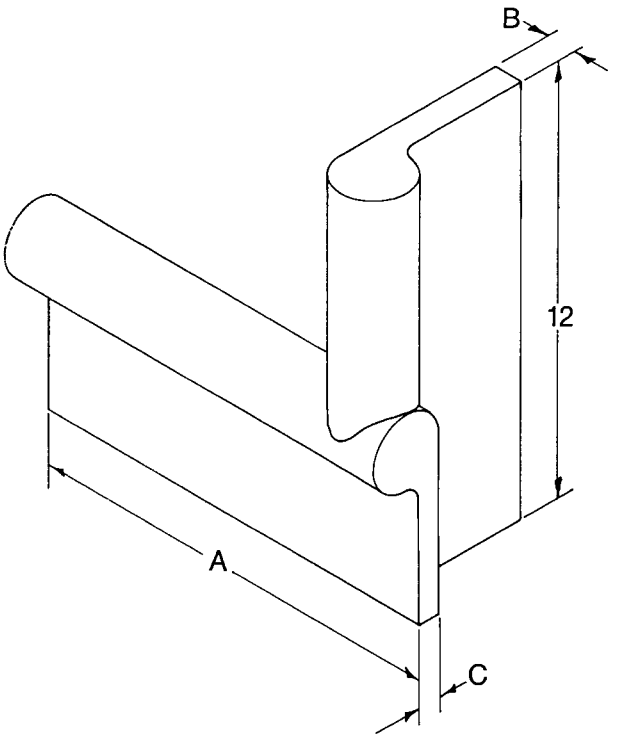
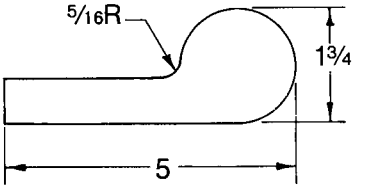
AS SHOWN AND OPPOSITE

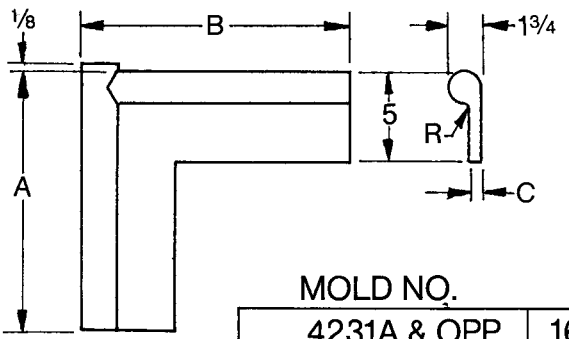




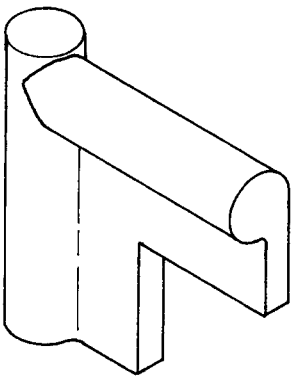
MOLD NO. 4955 & 4956
MOLD NO. 4955A & 4956A
AS SHOWN AND OPPOSITE



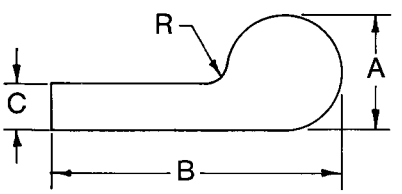
MOLD NO.	A	B	C
4955 & 4956	12 1/4	9/16	9/16
4955A & 4956A	12	9/16	7/8

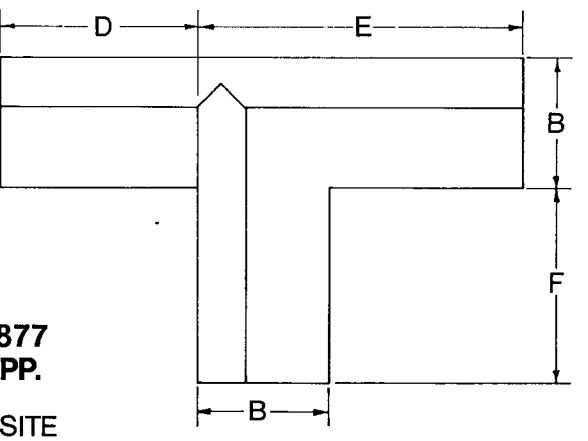


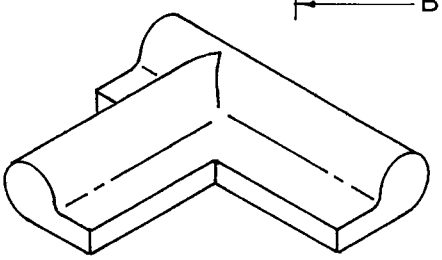
MOLD NO. 4231A & OPP.
MOLD NO. 3001 & OPP.



MOLD NO.	A	B	C	R
4231A & OPP.	16 1/2	17 3/4	9/16	5/16
3001 & OPP.	15	15	11/16	1/4







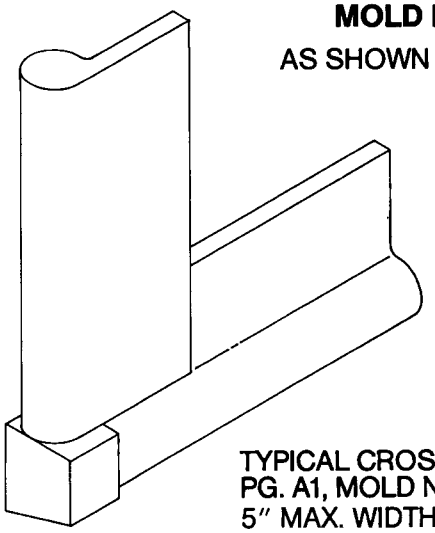
MOLD NO. 5876 & 5877
MOLD NO. 4231 & OPP.
AS SHOWN AND OPPOSITE

MOLD NO.	A	B	C	D	E	F	R
5876 & 5877	2 1/4	6**	3/4	9	15	9	5/16R
4231 & OPP.	1 3/4	5	9/16	9**	16 1/2	12 3/4	5/16R

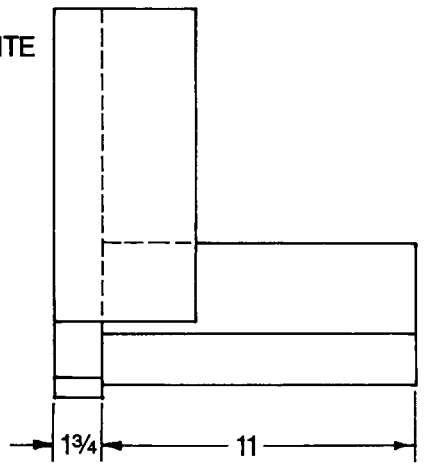
**MAX.

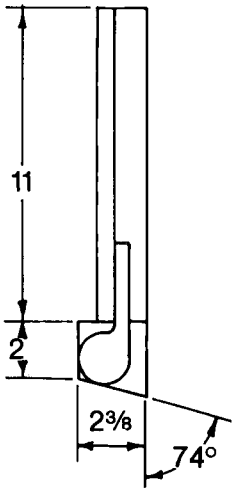
C-6

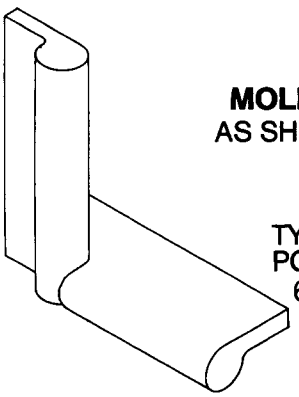
MOLD NO. 2247-C
AS SHOWN AND OPPOSITE



TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514
5″ MAX. WIDTH

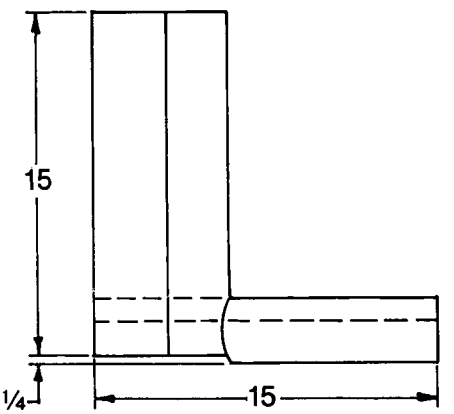


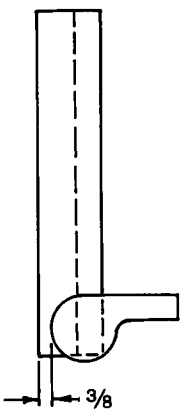


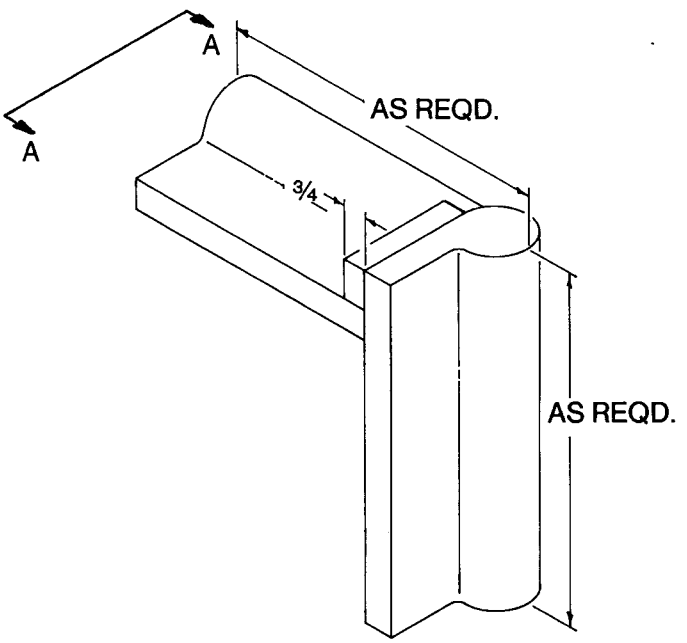


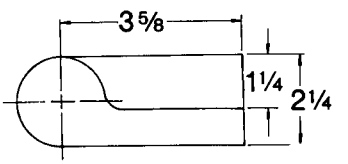
MOLD NO. 3703 & 3704
AS SHOWN AND OPPOSITE

TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2950
6″ MAX. WIDTH







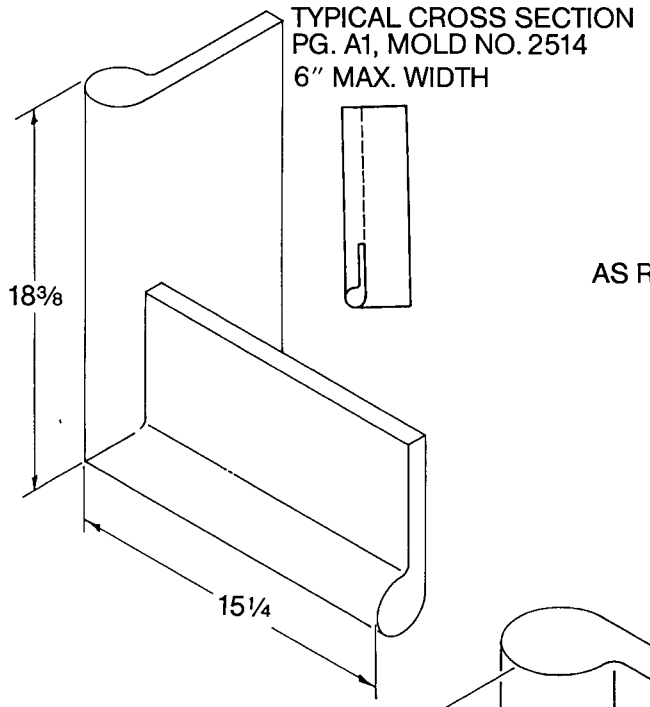


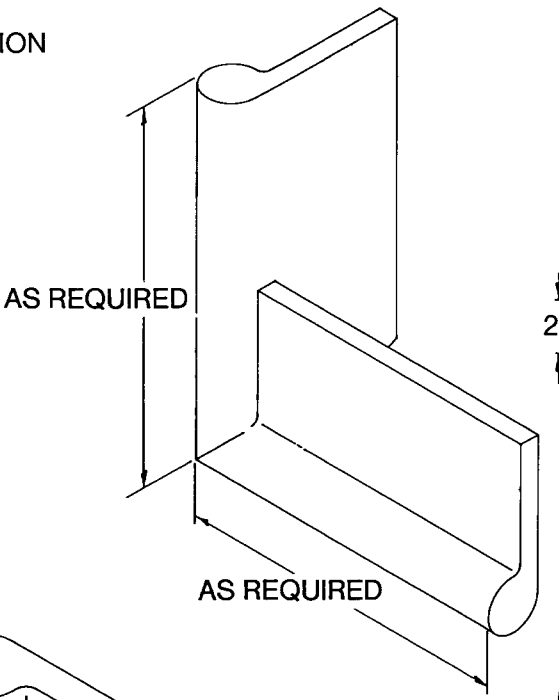
VIEW A-A

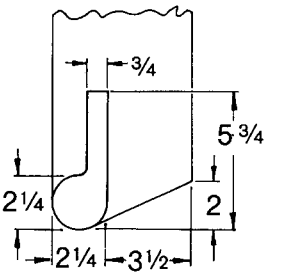
MOLD NO. 5641 & 5642
AS SHOWN AND OPPOSITE

TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2099
4¾ MAX. WIDTH

MOLD NO. 3220 & 3221
AS SHOWN AND OPPOSITE



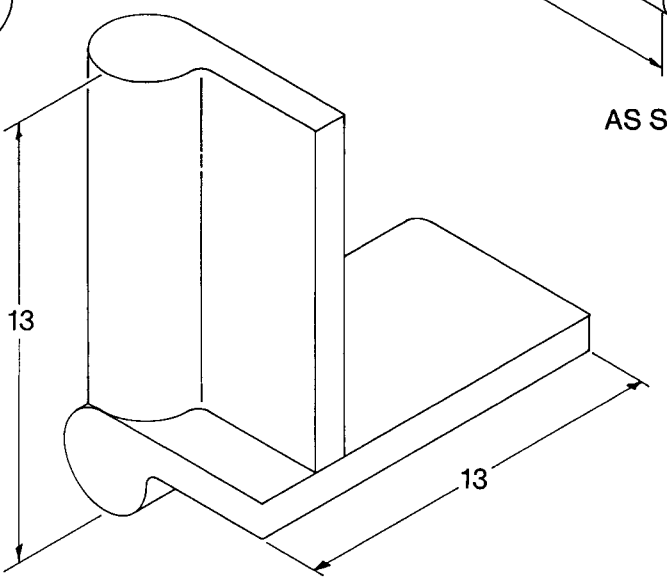


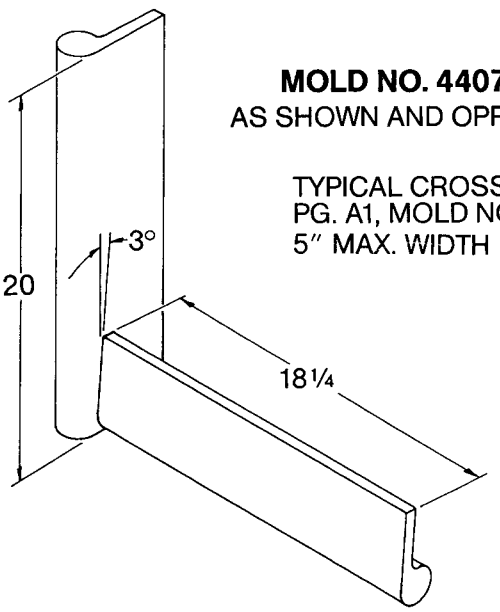


MOLD NO. 4236
AS SHOWN AND OPPOSITE

MOLD NO. 5997 & 5998
AS SHOWN AND OPPOSITE

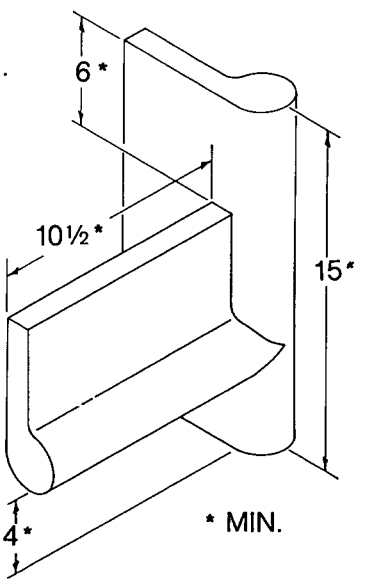
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 3602
6″ MAX. WIDTH





MOLD NO. 4407
AS SHOWN AND OPPOSITE

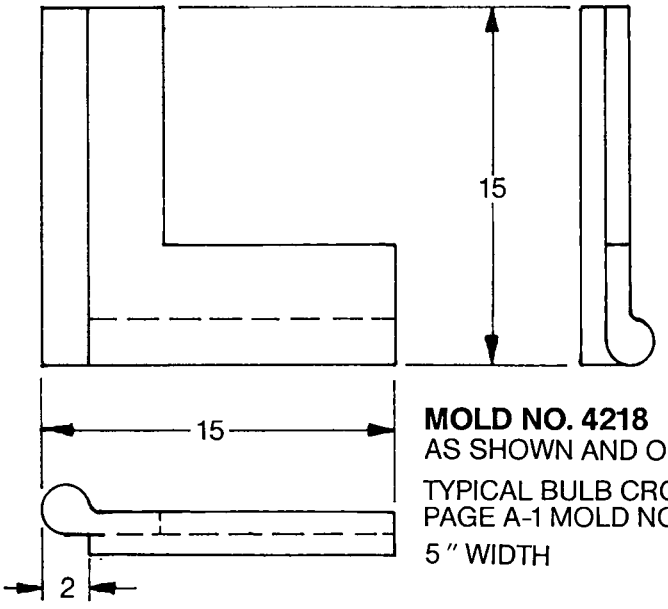
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514
5″ MAX. WIDTH



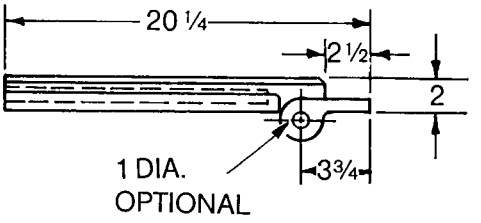
MOLD NO. 6386 & 6387
AS SHOWN AND OPPOSITE

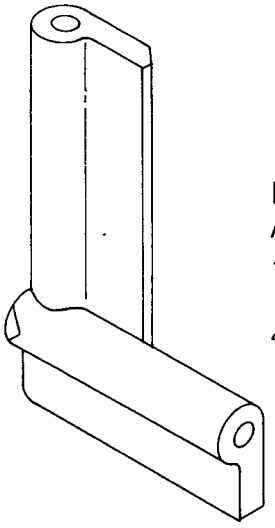
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2575
5″ MAX. WIDTH

C-8

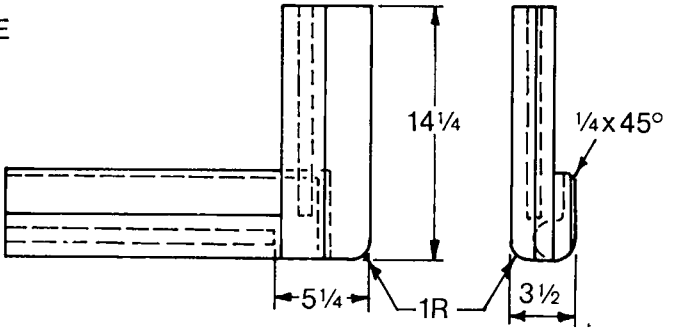


MOLD NO. 4218
AS SHOWN AND OPPOSITE
TYPICAL BULB CROSS SECTION
PAGE A-1 MOLD NO. 3073
5 " WIDTH

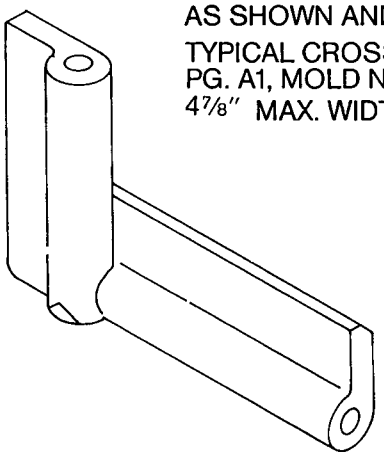


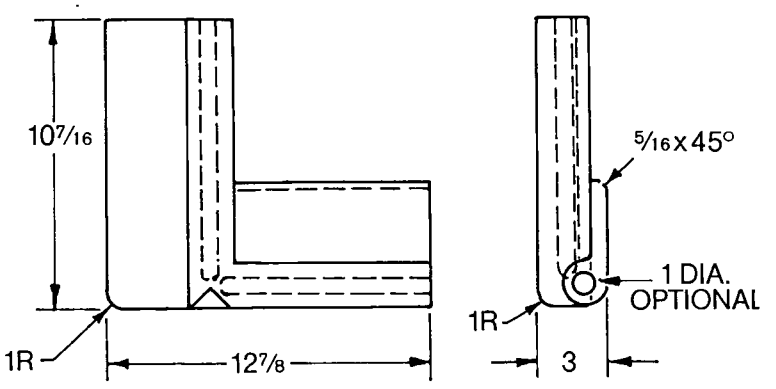


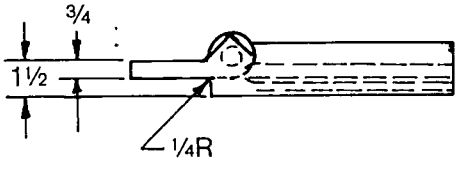
MOLD NO. 2589 & 2590
AS SHOWN AND OPPOSITE
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 3658
4 7/8" MAX. WIDTH

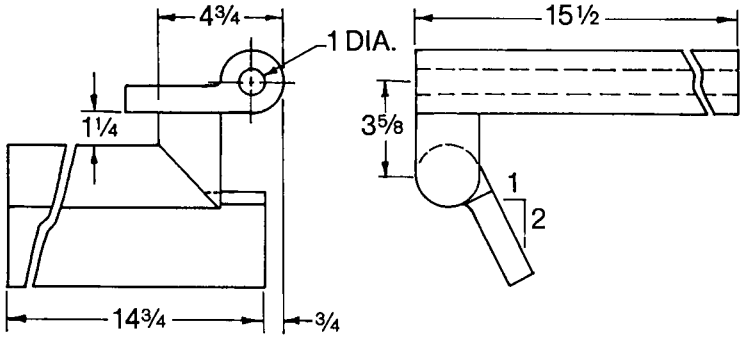


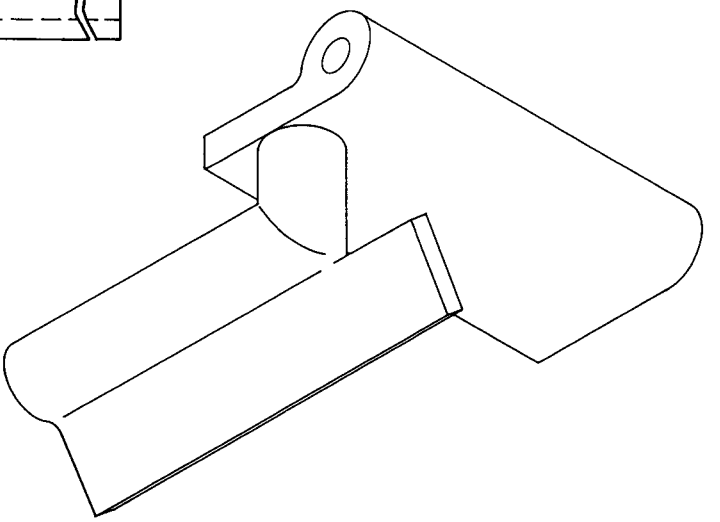
MOLD NO. 3696 & 3697
AS SHOWN AND OPPOSITE
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 3658
4 7/8" MAX. WIDTH



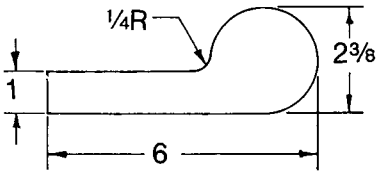




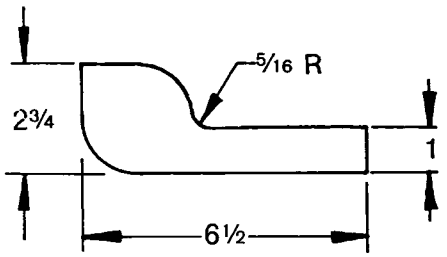


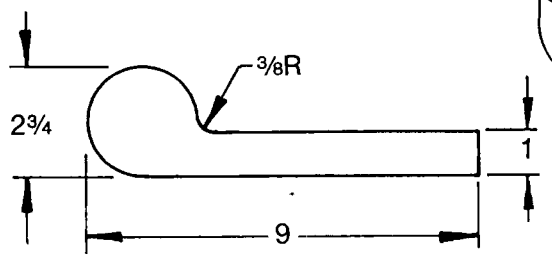


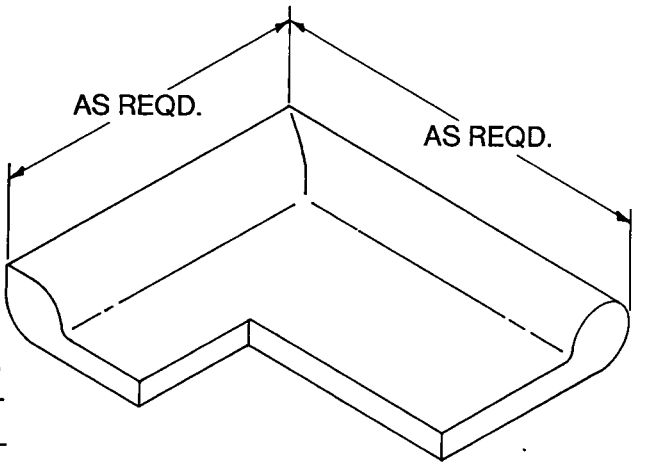
MOLD NO. 2682 & 2683
AS SHOWN AND OPPOSITE



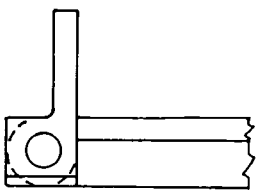
TYPICAL CROSS SECTION

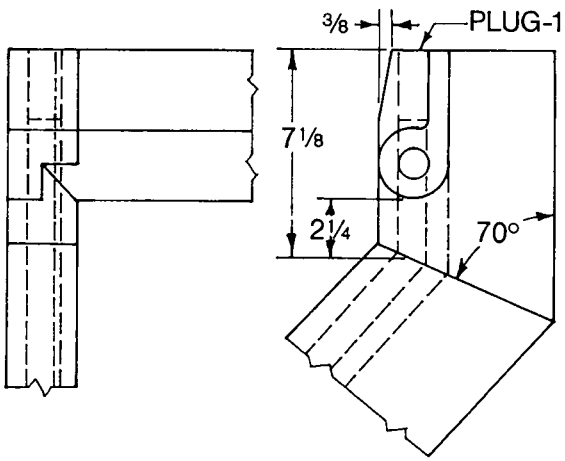




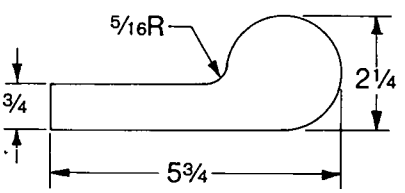


MOLD NO. 5986 & 5987
AS SHOWN AND OPPOSITE

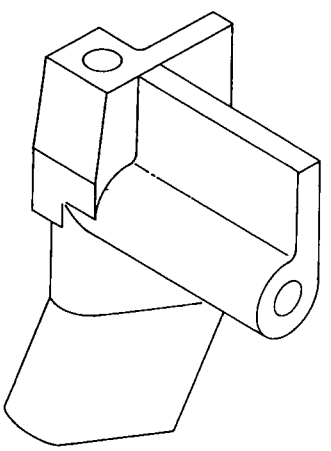




MOLD NO. 4234 & 4235
AS SHOWN AND OPPOSITE



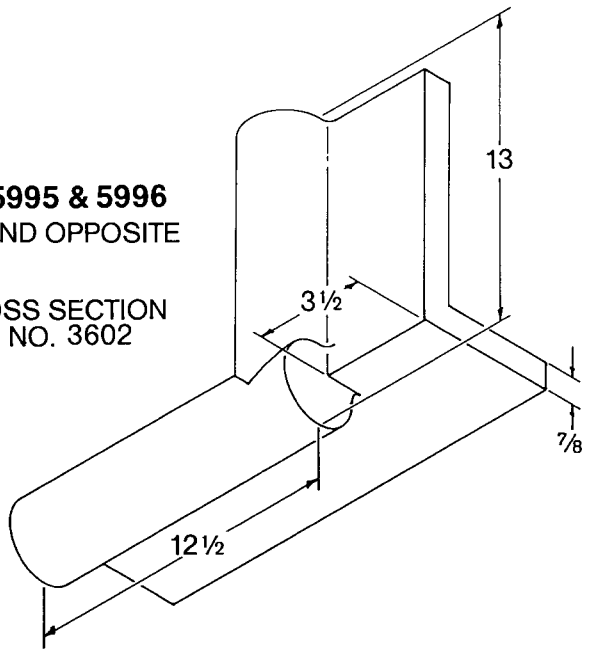
TYPICAL CROSS SECTION

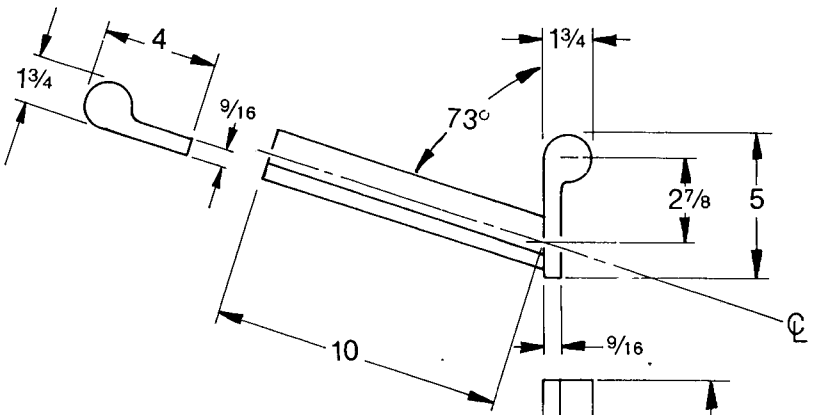


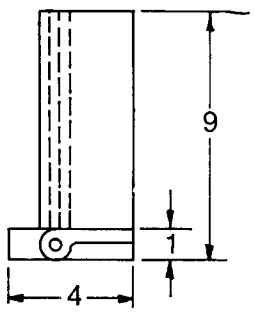
C-10

MOLD NO. 5995 & 5996
AS SHOWN AND OPPOSITE

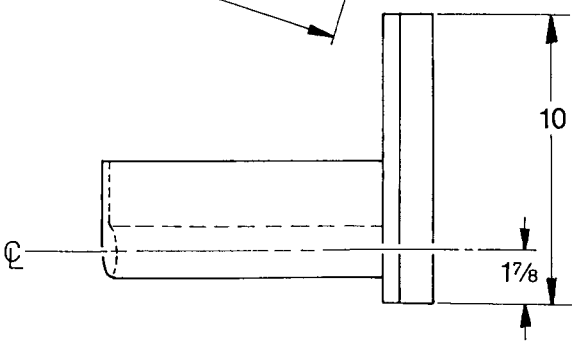
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 3602



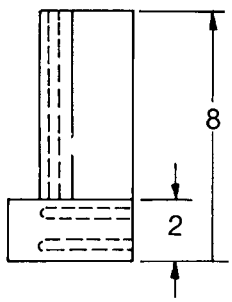


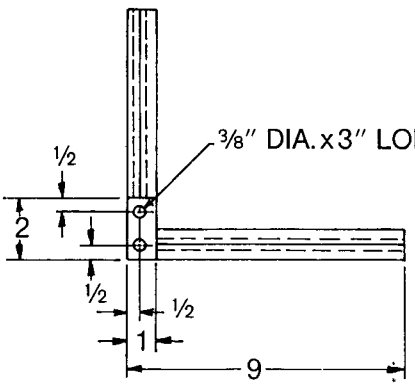


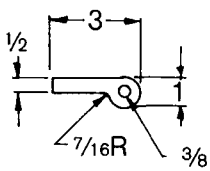
MOLD NO. 7113 & 7114
AS SHOWN AND OPPOSITE



MOLD NO. 6636 & 6637

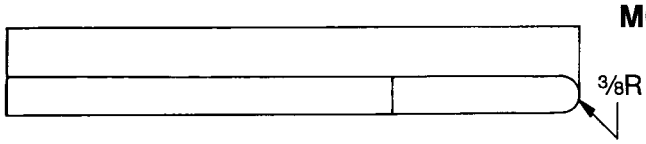






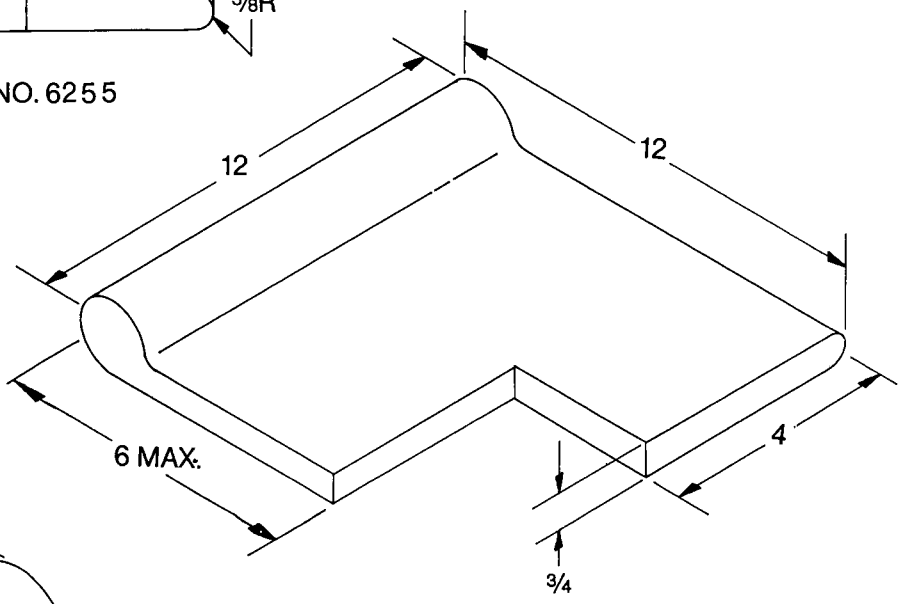
⅜ DIA. HOLE-OPTIONAL

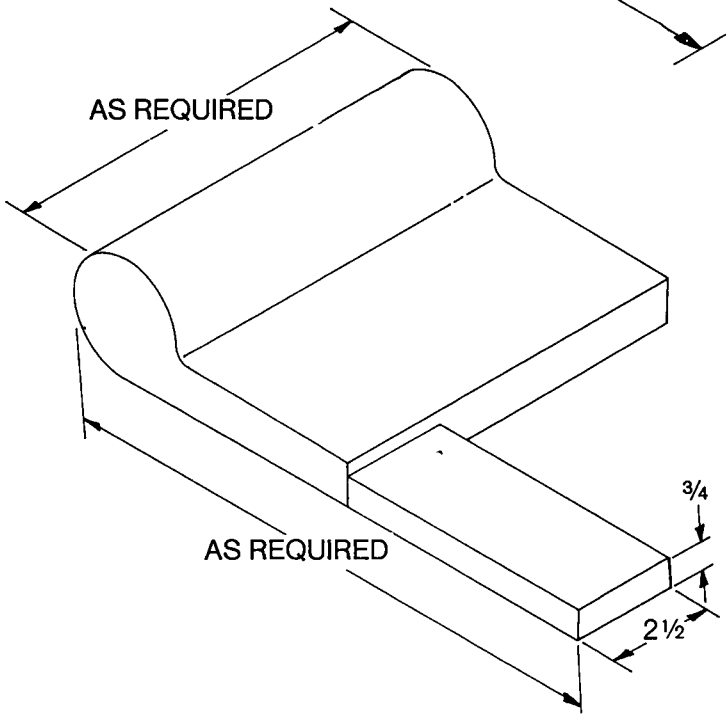
MOLD NO. 6205



FOR USE WITH MOLD NO. 6255

TYPICAL CROSS SECTION
PG. A1, MOLD NO. 3762



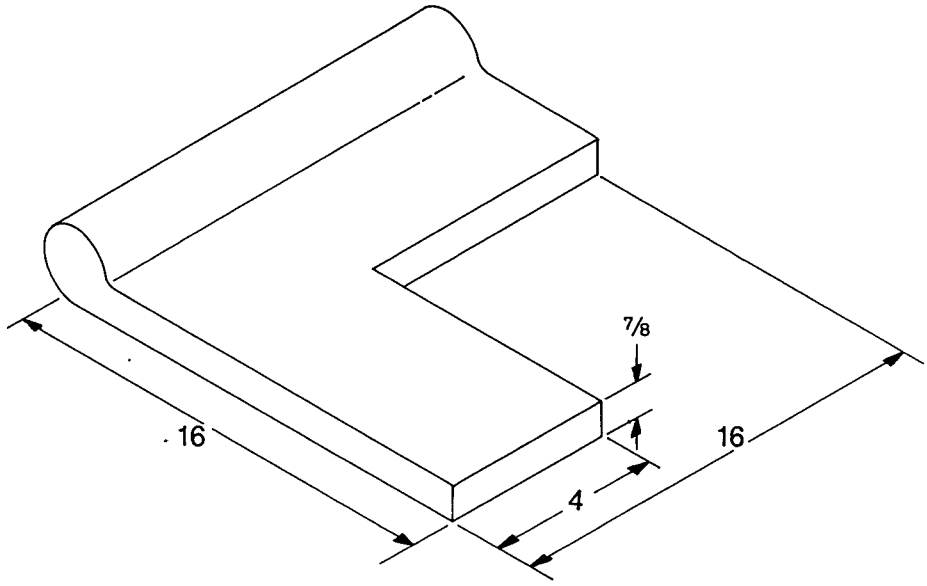


MOLD NO. 4754
AS SHOWN AND OPPOSITE

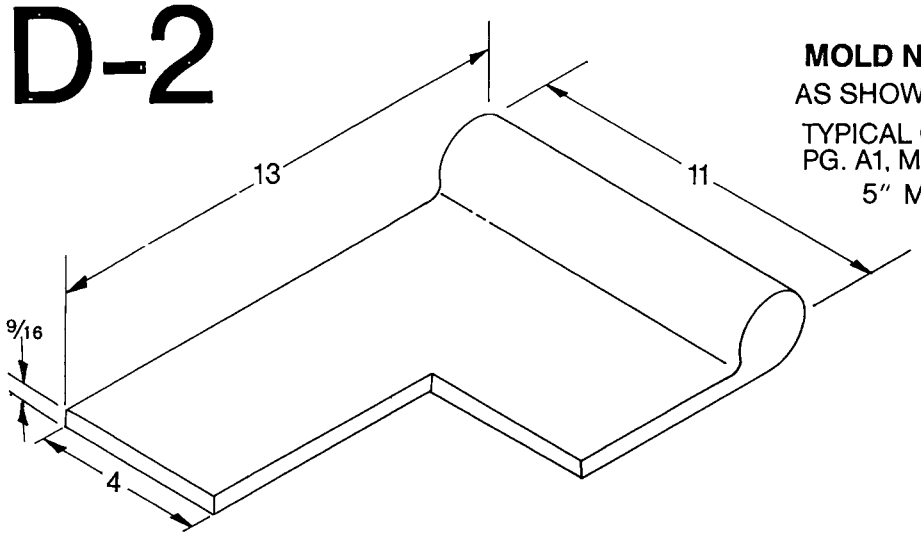
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2950
6" MAX. WIDTH

MOLD NO. 6184
AS SHOWN AND OPPOSITE

TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2575

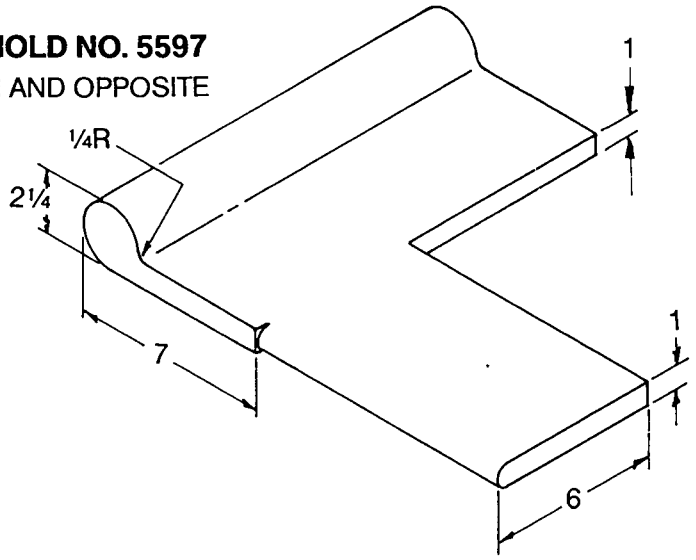


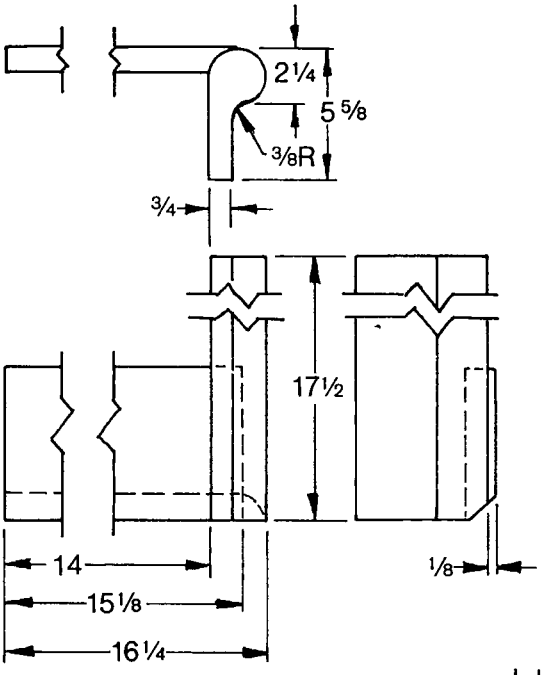
D-2



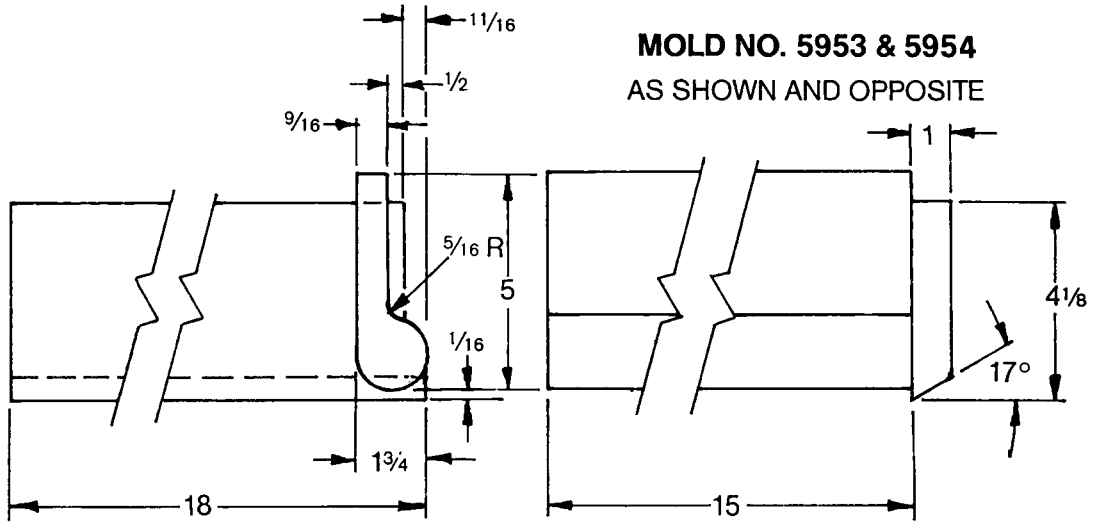
MOLD NO. 3725 & 3726
AS SHOWN AND OPPOSITE
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514
5" MAX. WIDTH

MOLD NO. 5597
AS SHOWN AND OPPOSITE



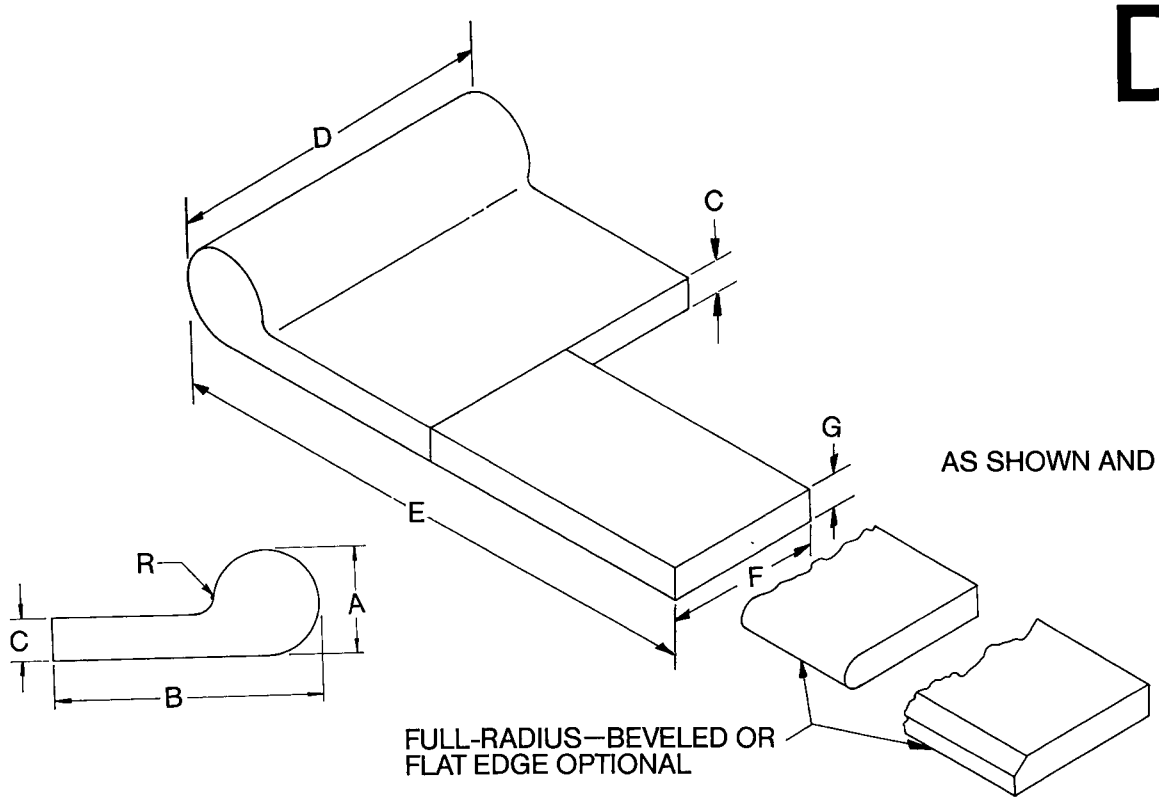


MOLD NO. YM795
AS SHOWN AND OPPOSITE



MOLD NO. 5953 & 5954
AS SHOWN AND OPPOSITE

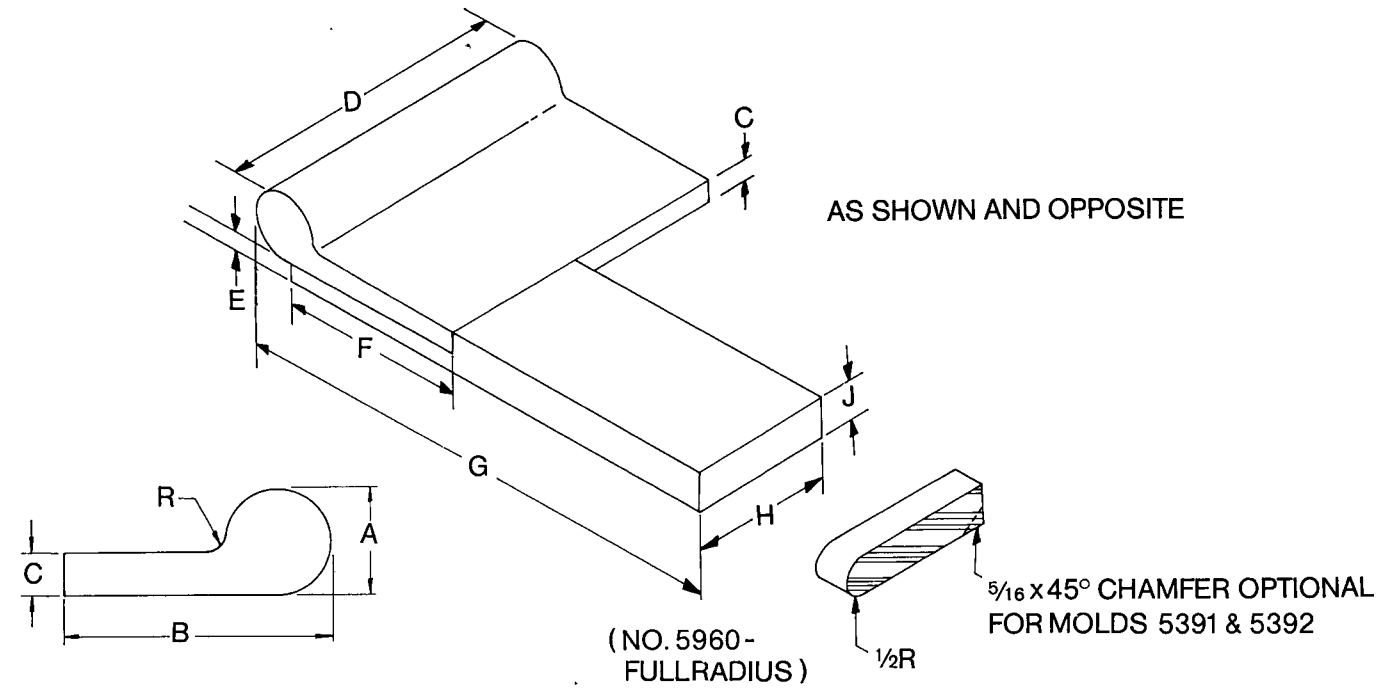
D-3



AS SHOWN AND OPPOSITE

MOLD NO.	A	B	C	D	E	F	G	R
3829	2 1/4	9**	3/4	***	***	4**	5/8 OR 3/4	5/16R
5960-A	7/8	2 1/4	5/16	***	***	2 1/2**	5/16	1/8R
5831	1 3/4	5**	11/16	***	***	4**	11/16	1/4R

*** AS REQUIRED **MAX.

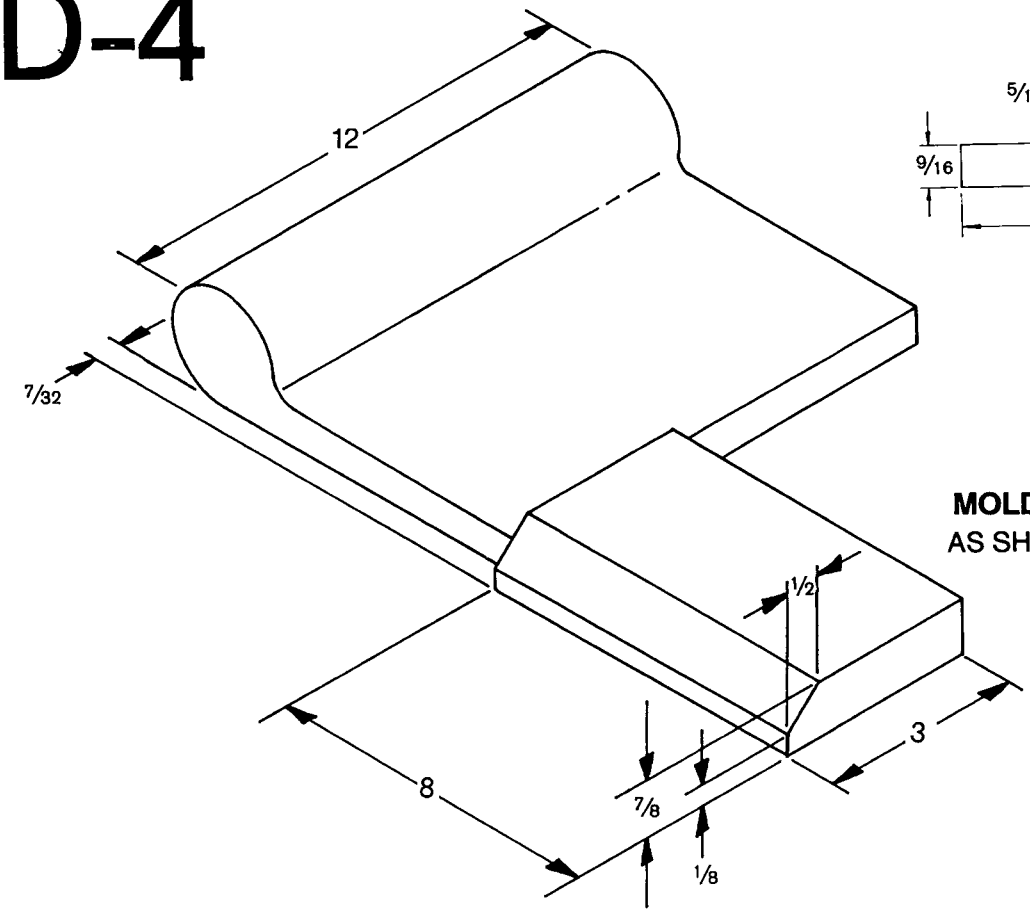


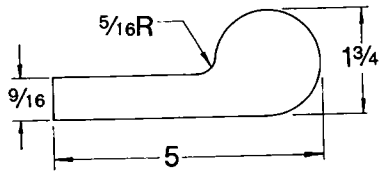
AS SHOWN AND OPPOSITE

MOLD NO.	A	B	C	D	E	F	G	H	J	R
5960	7/8	2 1/4	5/16	***	5/16	1 1/4	***	2	5/8	1/8R
5391 & 5392	1 3/4	5	9/16	***	7/16	4 1/8	***	3 1/2	1	5/16R

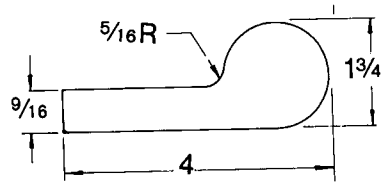
*** AS REQUIRED

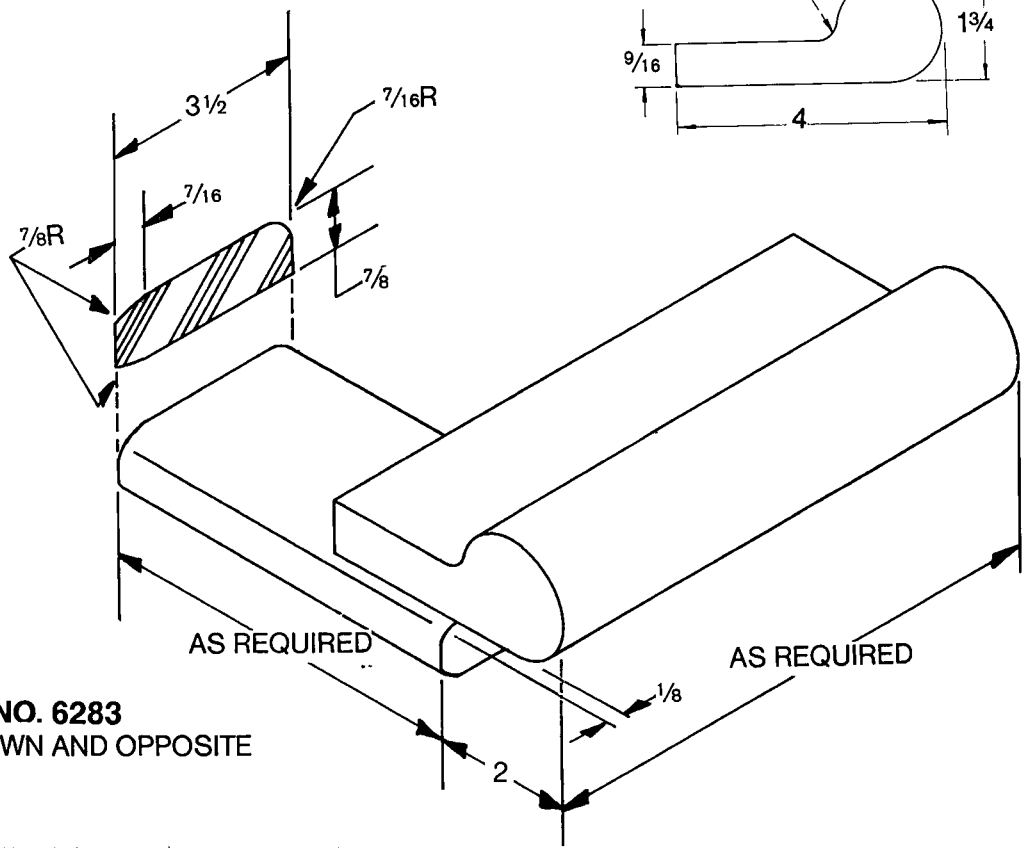
D-4



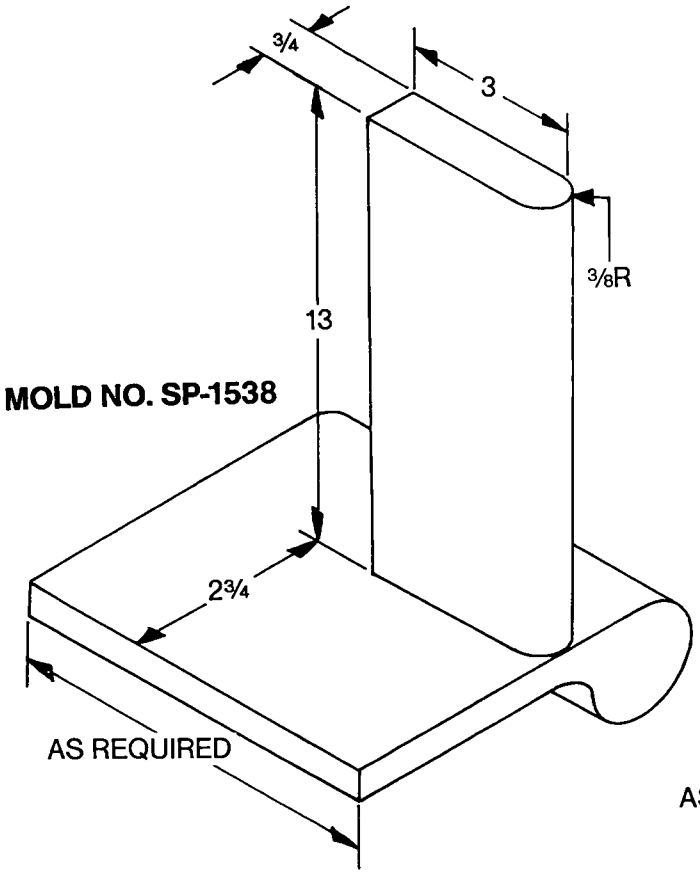


MOLD NO. 4937
AS SHOWN AND OPPOSITE

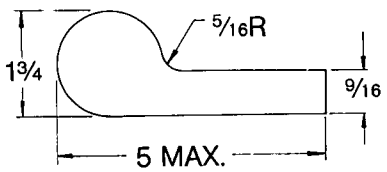




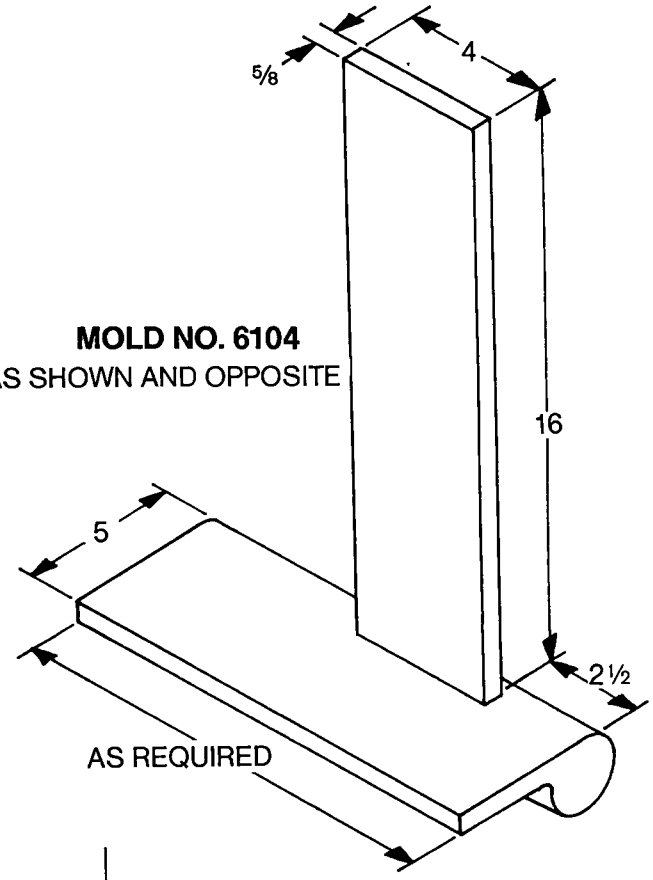
MOLD NO. 6283
AS SHOWN AND OPPOSITE



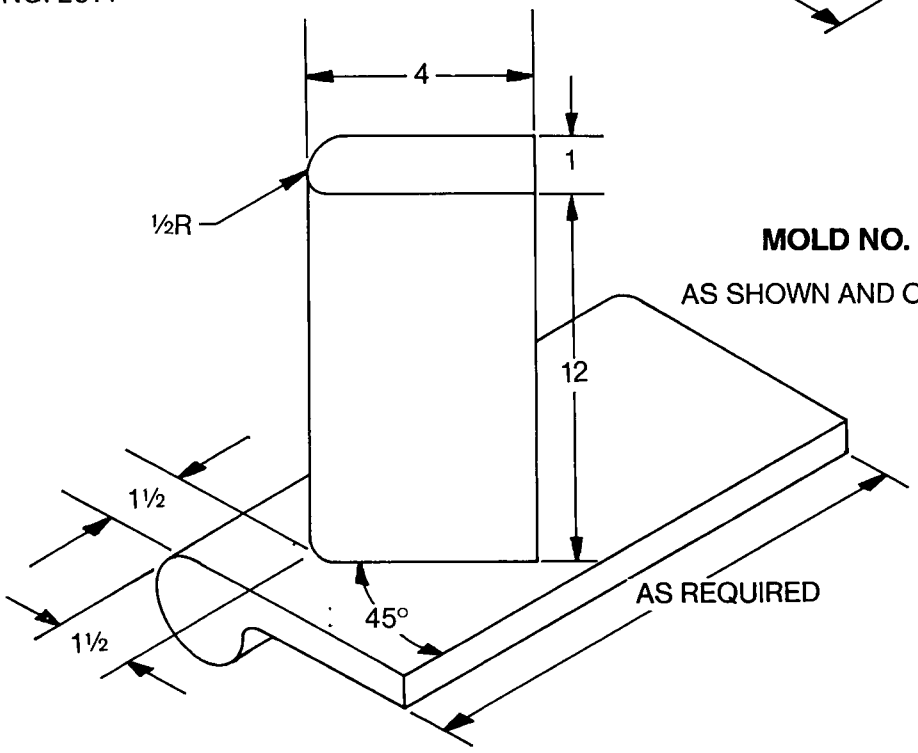
MOLD NO. SP-1538



TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE
PER MOLD NO. 2514



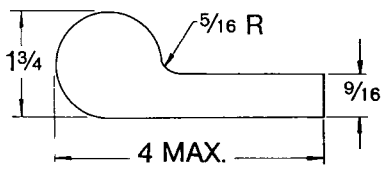
MOLD NO. 6104
AS SHOWN AND OPPOSITE

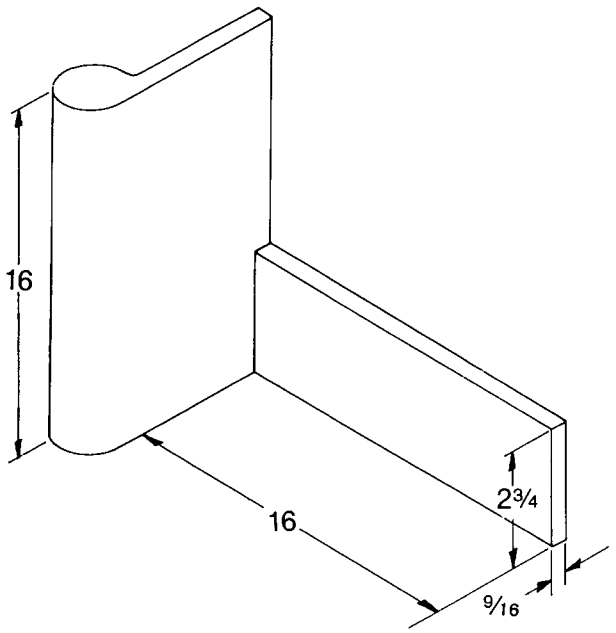


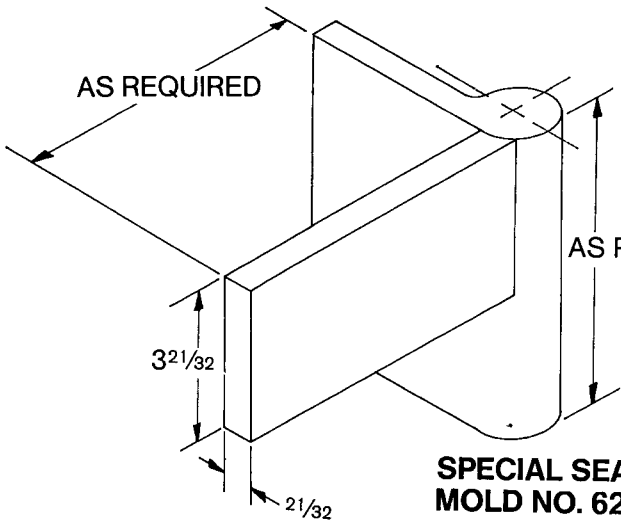
MOLD NO. 6443
AS SHOWN AND OPPOSITE

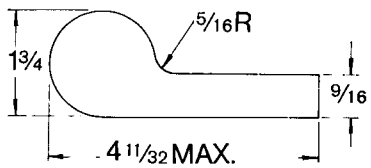
D-6

FABRICATED CORNER
MOLD NO. 4170
AS SHOWN AND OPPOSITE



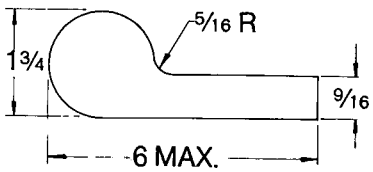


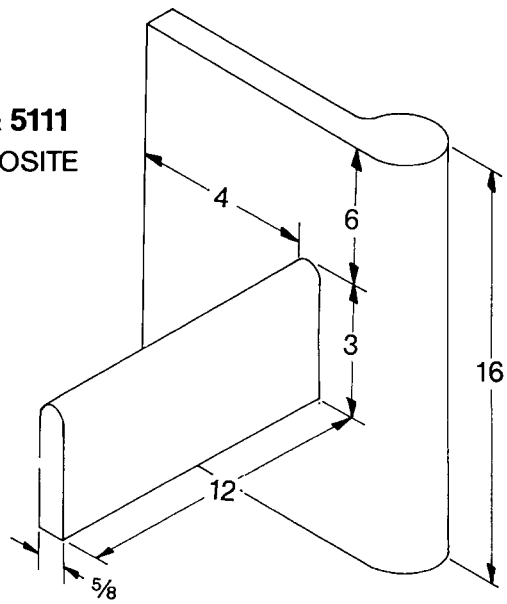




SPECIAL SEAL CORNERS
MOLD NO. 6280 & 6281
AS SHOWN AND OPPOSITE

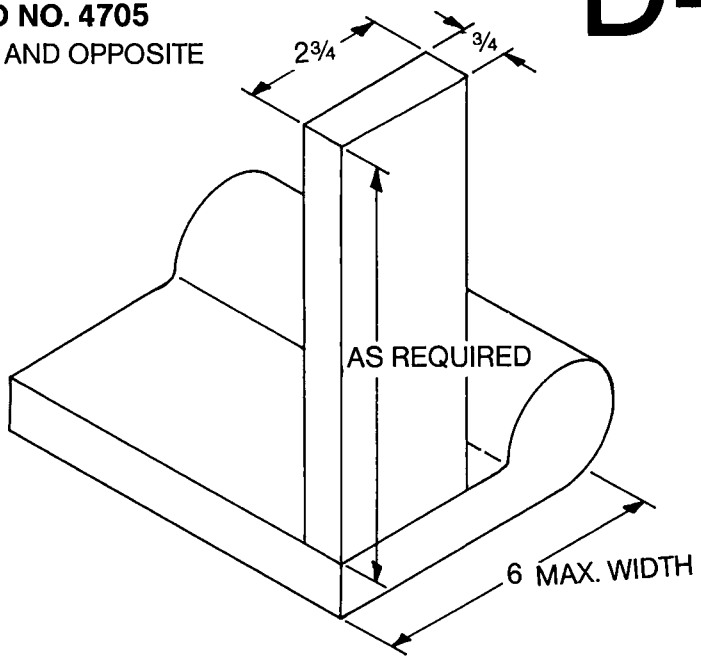
MOLD NO. 5110 & 5111
AS SHOWN AND OPPOSITE

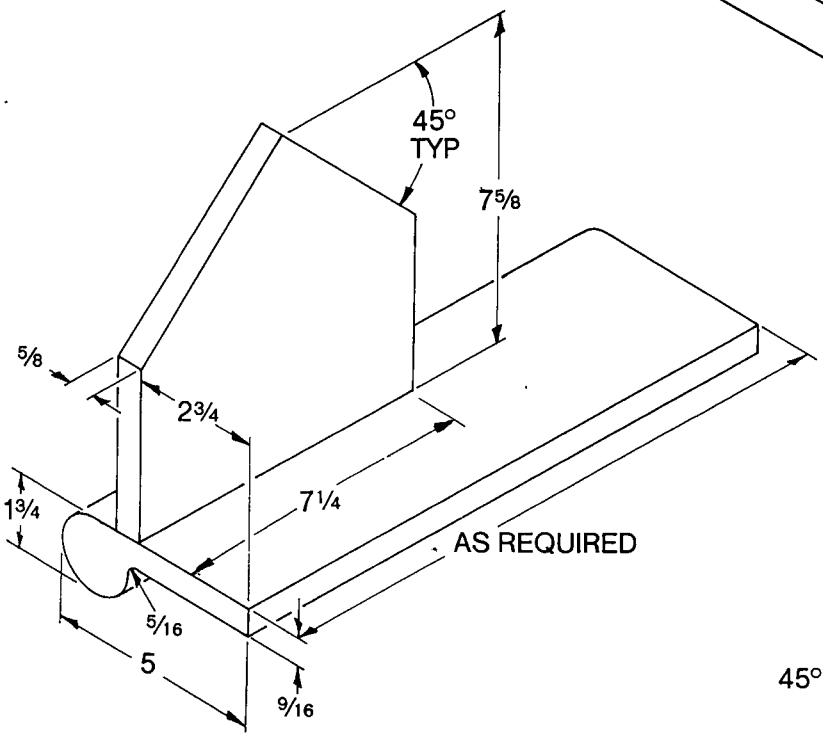




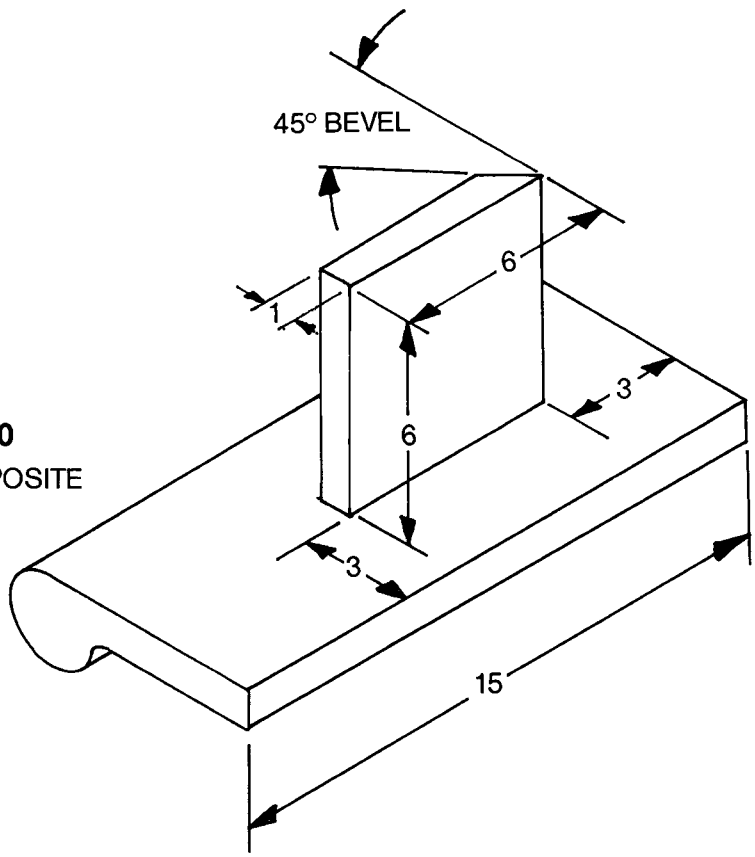
MOLD NO. 4705
AS SHOWN AND OPPOSITE

TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2099





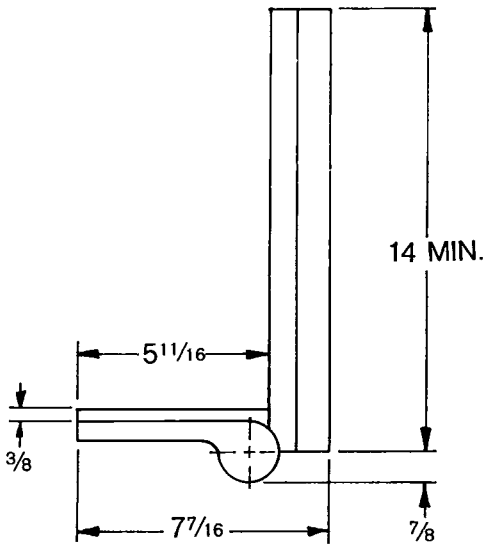
SPECIAL BOTTOM CORNER
MOLD NO. 6879
AS SHOWN AND OPPOSITE

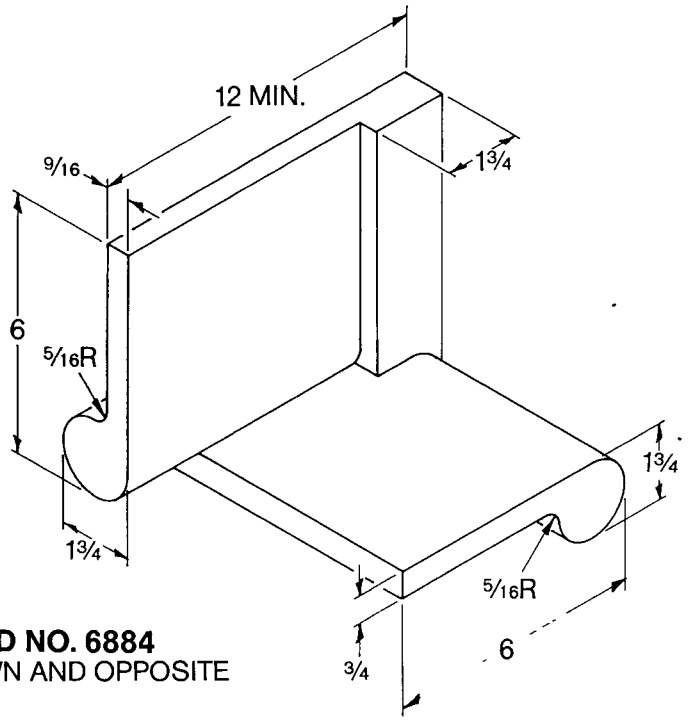


MOLD NO. 5500
AS SHOWN AND OPPOSITE

TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2950
6″ MAX. WIDTH

D-8

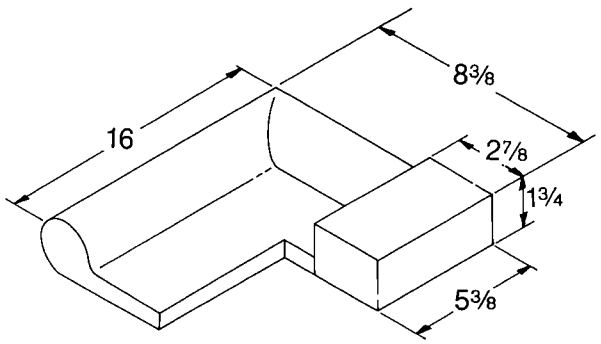


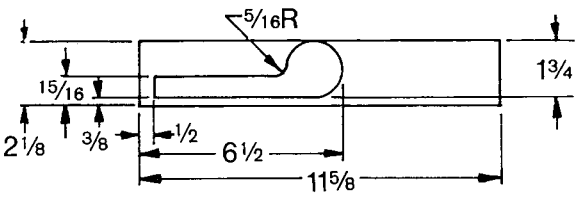


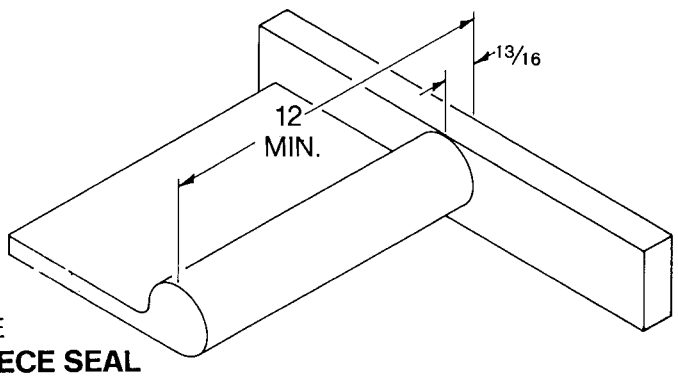
MOLD NO. 6884
AS SHOWN AND OPPOSITE

MOLD NO. 4939 & 4940
AS SHOWN AND OPPOSITE

TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514
5" MAX. WIDTH

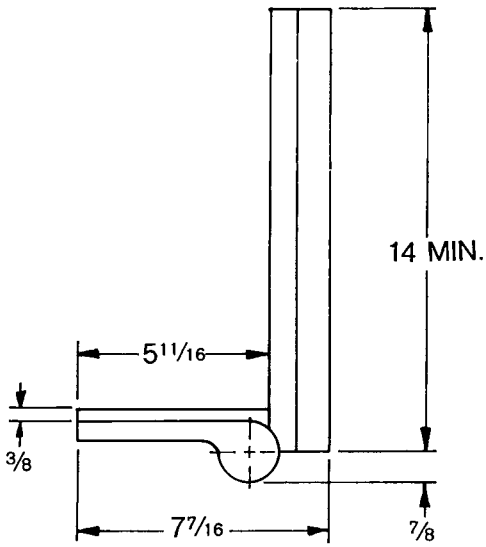


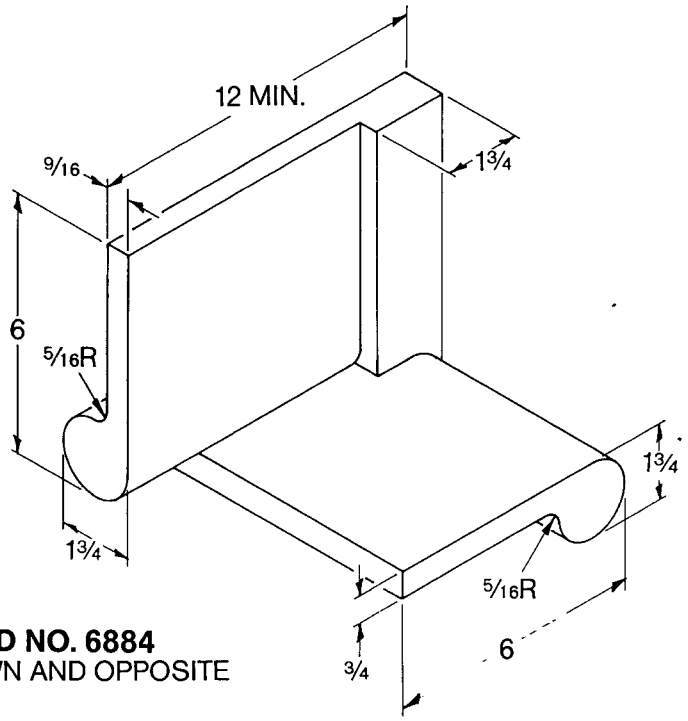




MOLD NO. 6885
AS SHOWN AND OPPOSITE
SPECIAL MOLDED RUBBER END PIECE SEAL

D-8

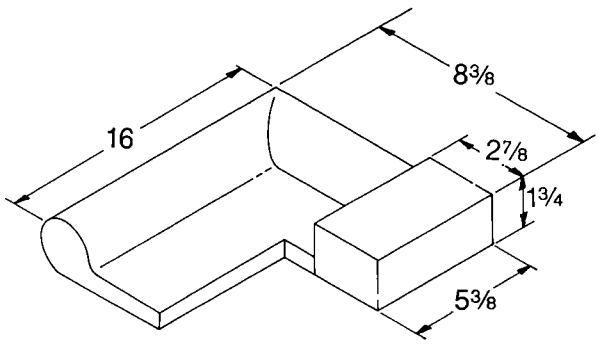


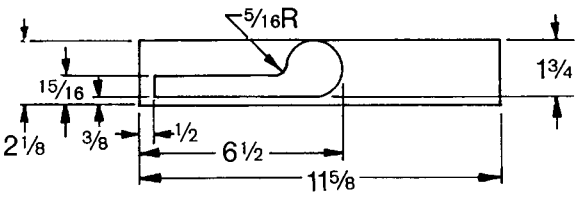


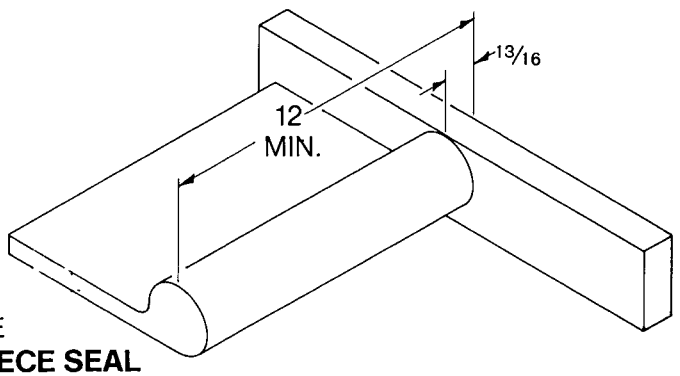
MOLD NO. 6884
AS SHOWN AND OPPOSITE

MOLD NO. 4939 & 4940
AS SHOWN AND OPPOSITE

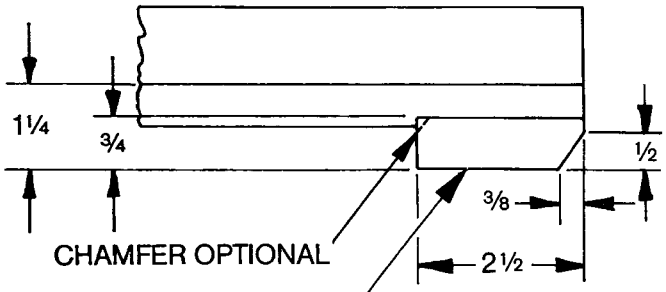
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514
5" MAX. WIDTH

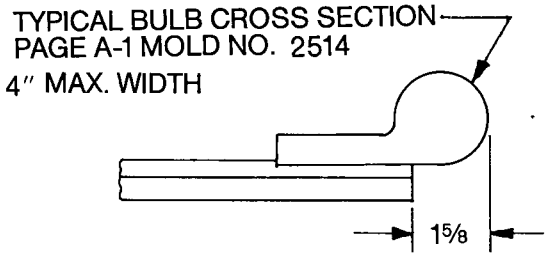




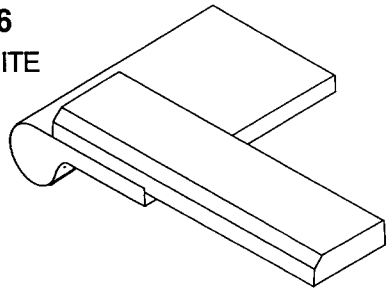


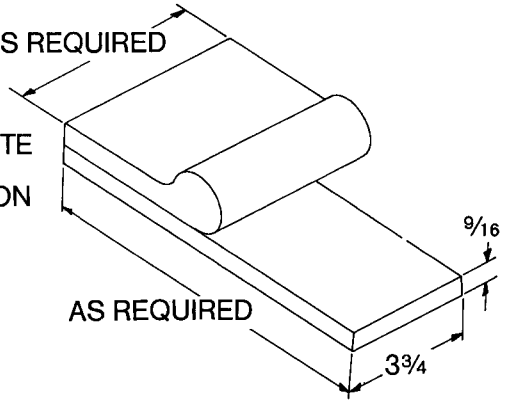
MOLD NO. 6885
AS SHOWN AND OPPOSITE
SPECIAL MOLDED RUBBER END PIECE SEAL





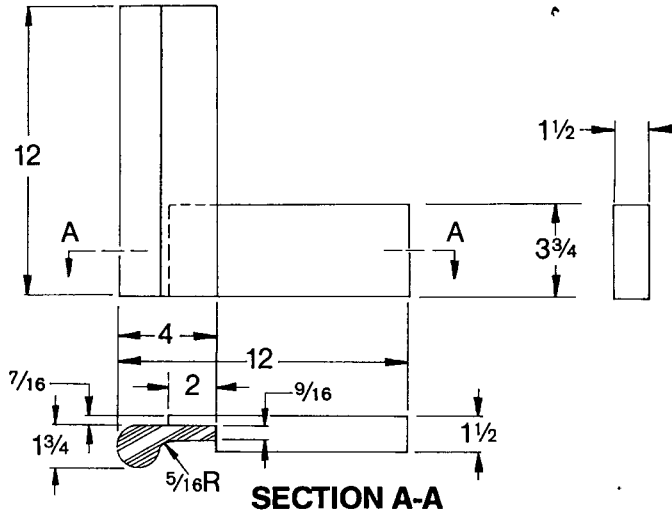
MOLD NO. DR-5316
AS SHOWN AND OPPOSITE





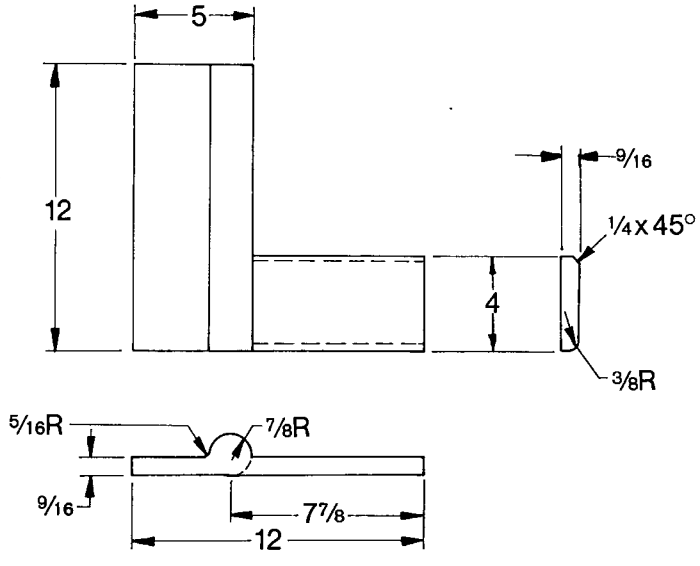
MOLD NO. 5692
AS SHOWN AND OPPOSITE

TYPICAL BULB CROSS SECTION
PAGE A-1 MOLD NO. 2514
5″ MAX. WIDTH



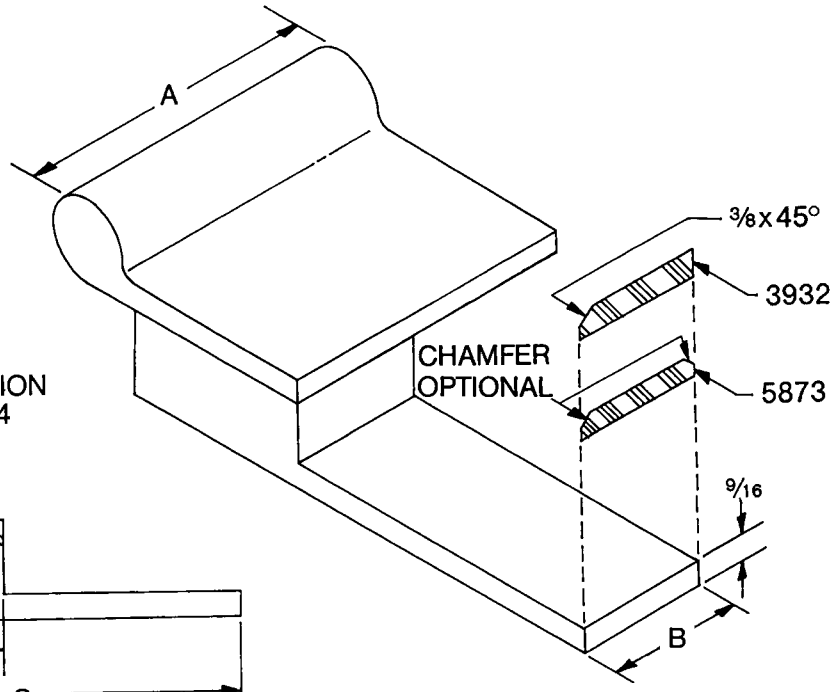
SECTION A-A

MOLD NO. 6853
AS SHOWN AND OPPOSITE

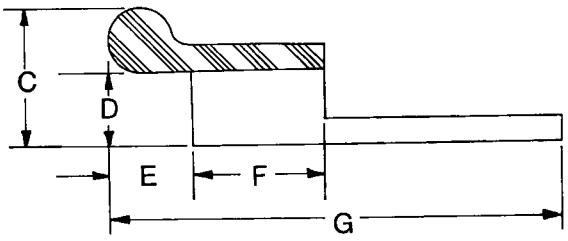


MOLD NO. 7093
AS SHOWN AND OPPOSITE

D-10

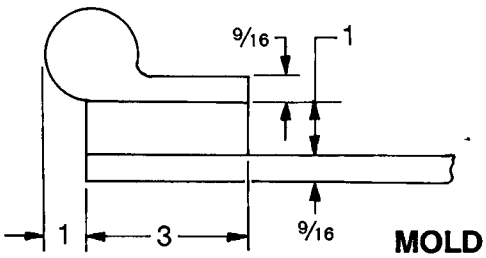


TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514
5″ MAX. WIDTH



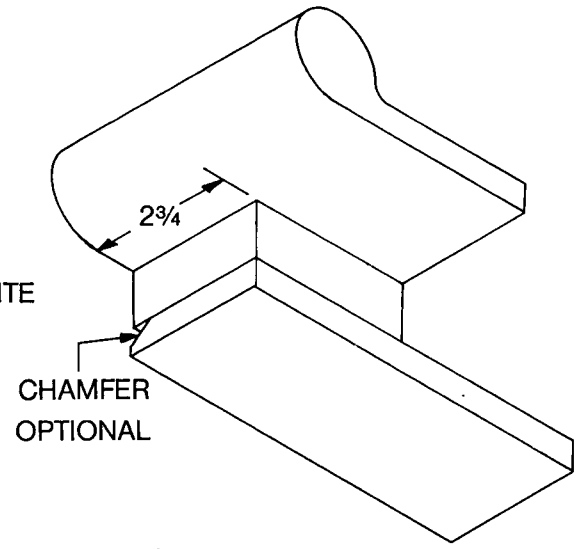
MOLD NO.	A	B	C	D	E	F	G
3932	ANY	3	3¾	2	2 ⅜	2⅝	17⅜
5873	***	2¾	3 9/16	1 13/16	2	3	***

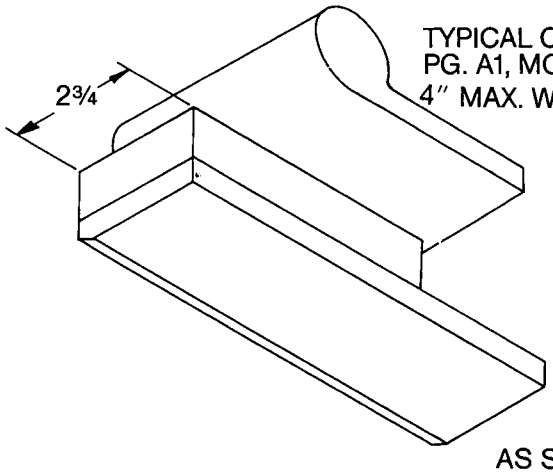
***AS REQUIRED



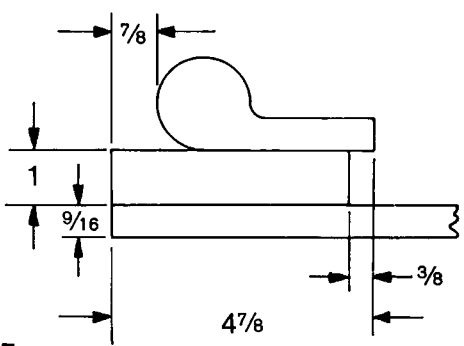
MOLD NO. 4674
AS SHOWN AND OPPOSITE

TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514
4″ MAX. WIDTH

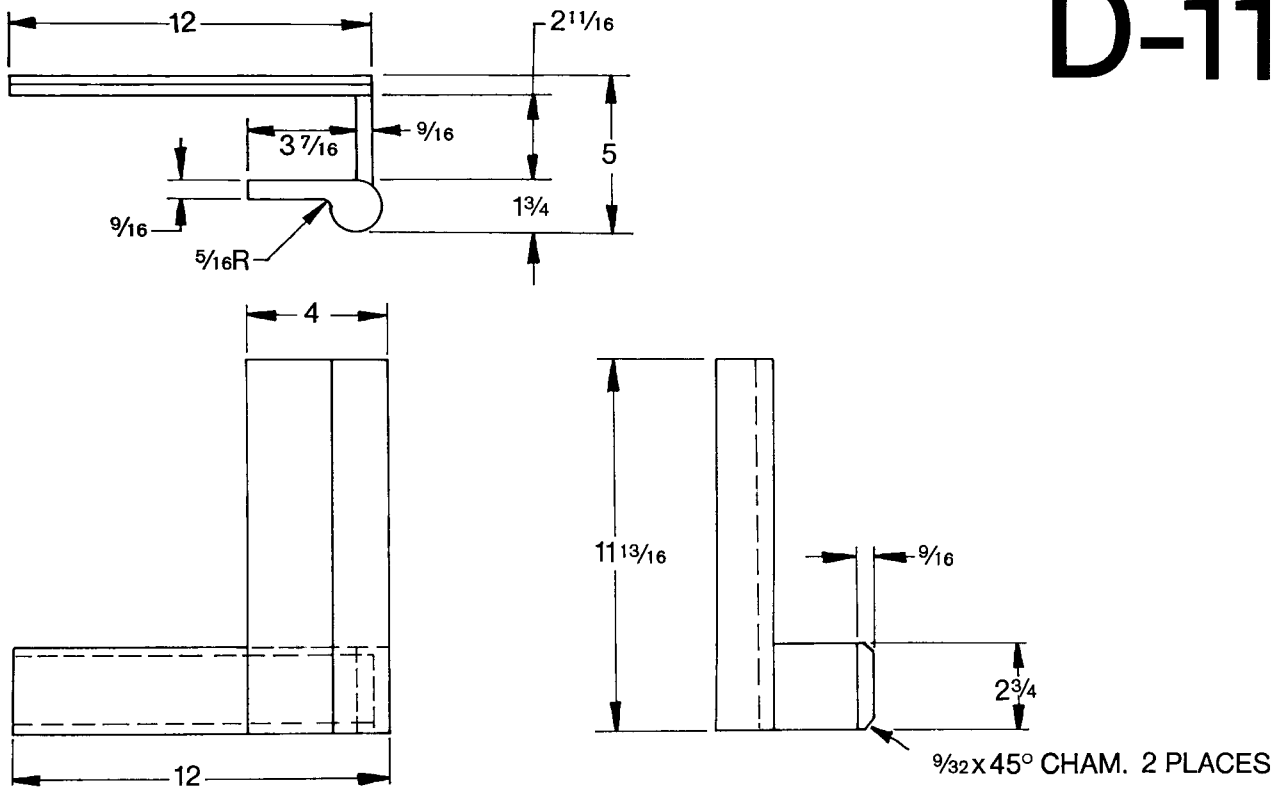




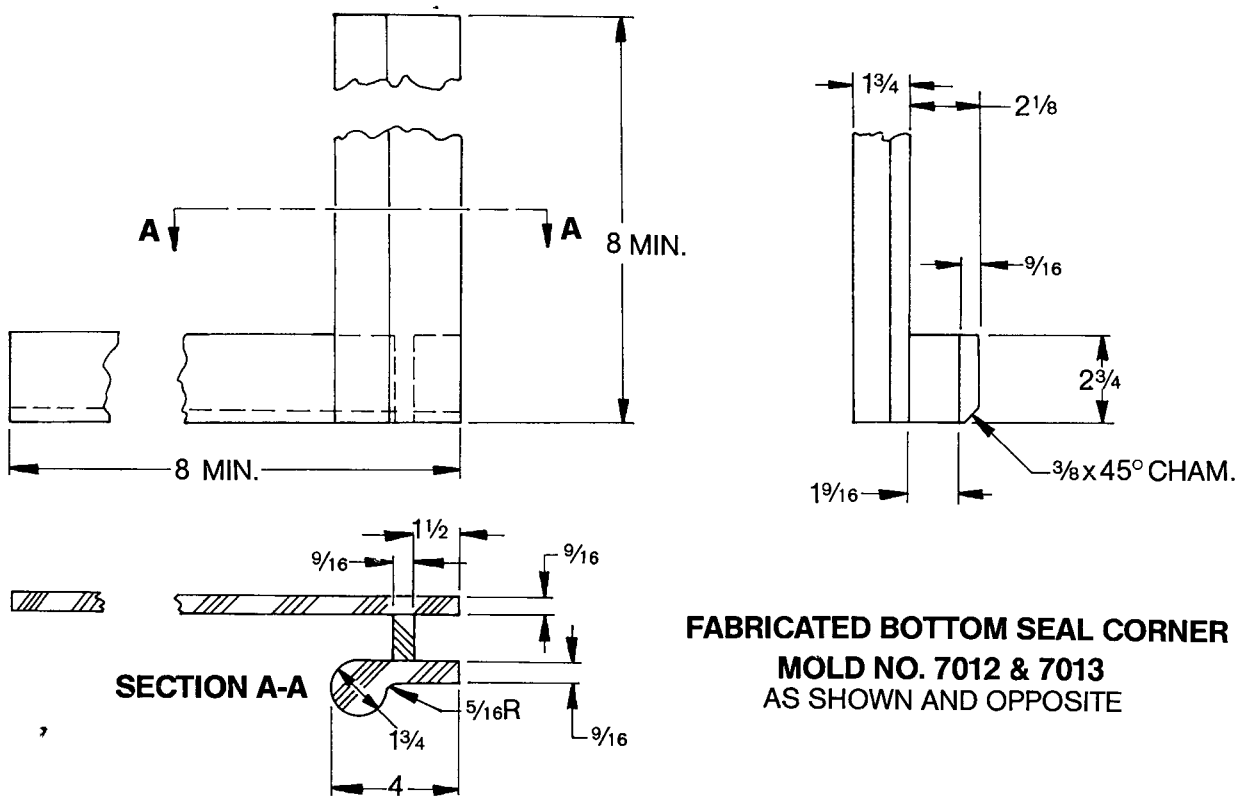
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514
4″ MAX. WIDTH



MOLD NO. 4675
AS SHOWN AND OPPOSITE

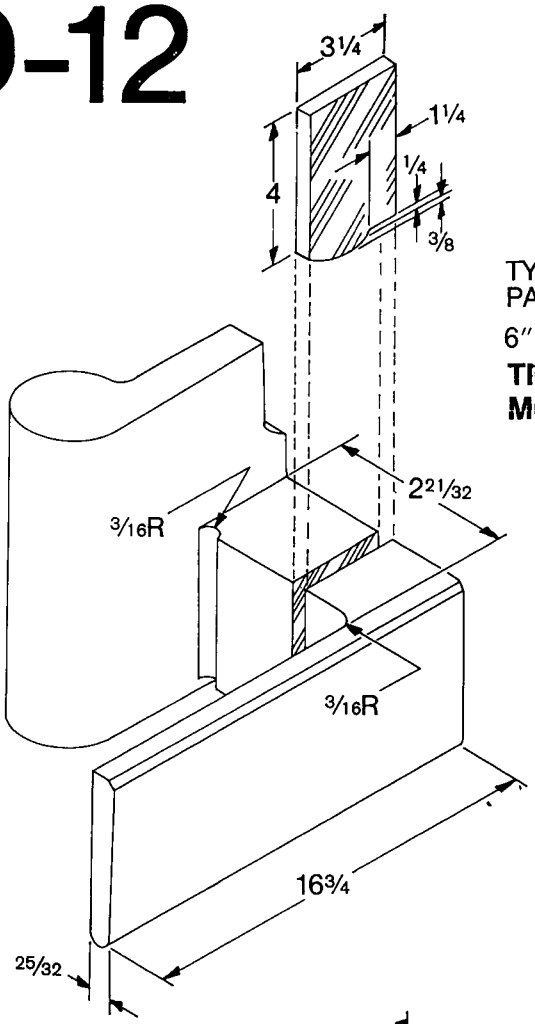


RUBBER GATE SEAL, BOTTOM CORNER
MOLD NO. 7043
AS SHOWN AND OPPOSITE



FABRICATED BOTTOM SEAL CORNER
MOLD NO. 7012 & 7013
AS SHOWN AND OPPOSITE

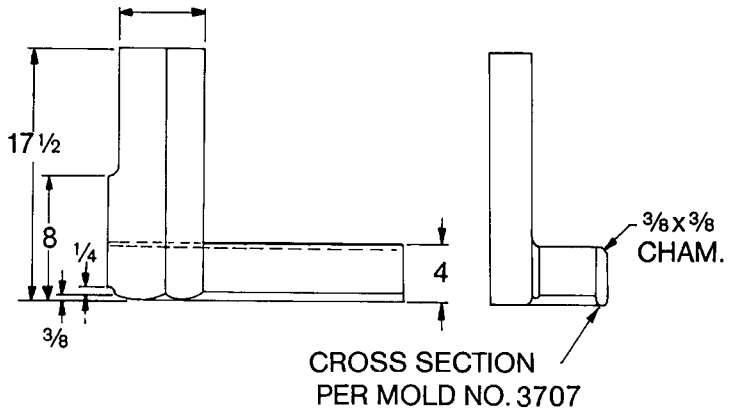
D-12



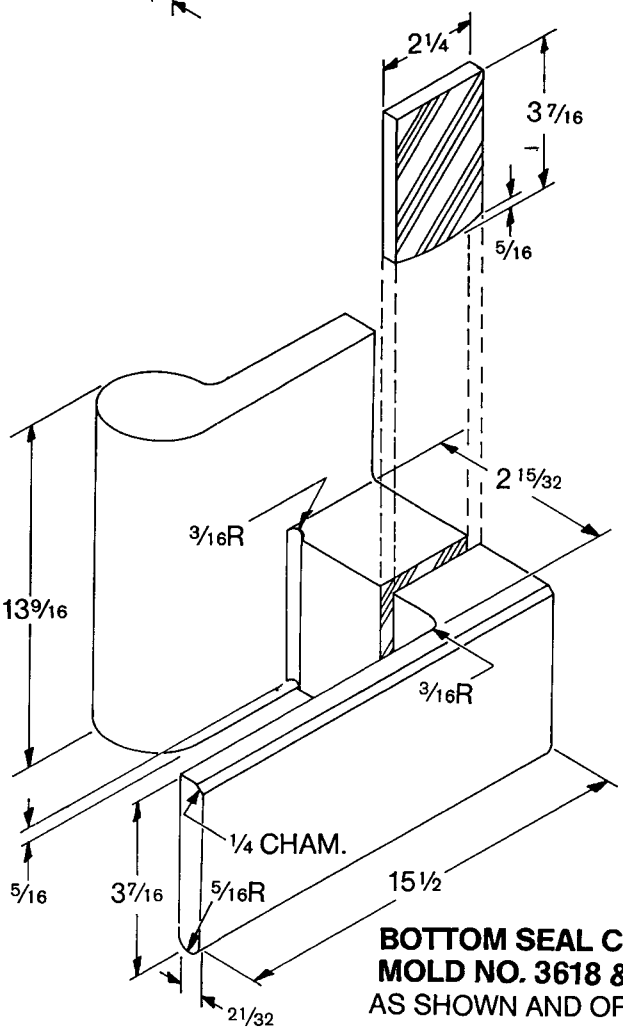
TYPICAL BULB CROSS SECTION
PAGE A-1 MOLD NO.2950

6" MAX. WIDTH

TRANSITION CORNER MOLD
MOLD NO. 3716 & 3717

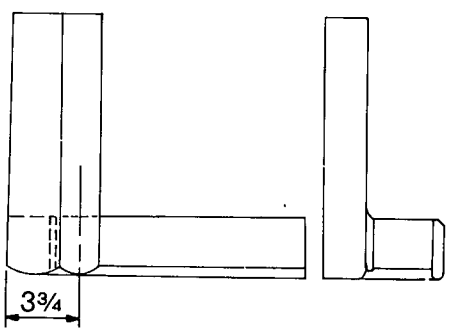


CROSS SECTION
PER MOLD NO. 3707



TYPICAL BULB CROSS SECTION
PAGE A-1 MOLD NO. 3658

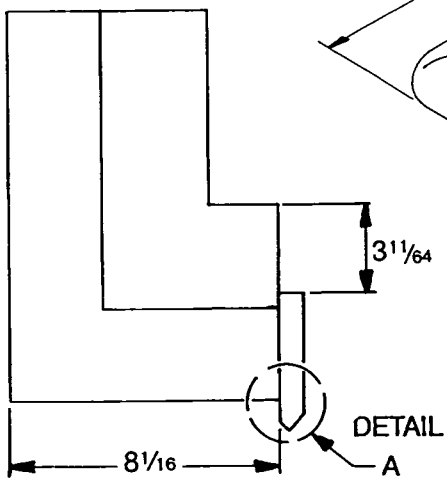
4⅞" MAX. WIDTH

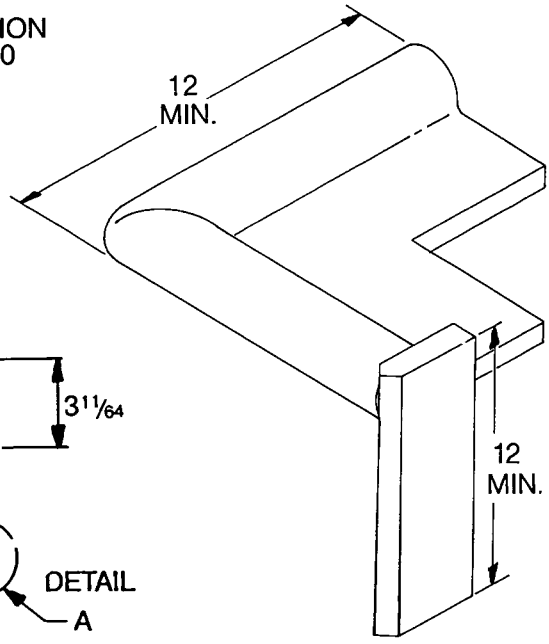


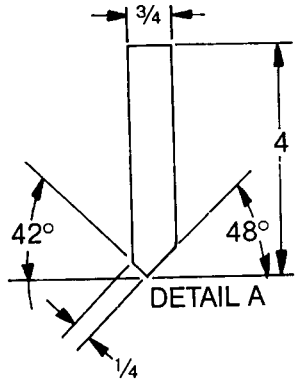
BOTTOM SEAL CORNER
MOLD NO. 3618 & 3619
AS SHOWN AND OPPOSITE

TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2950

6" MAX. WIDTH





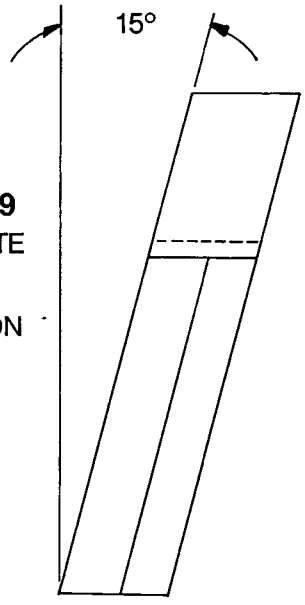


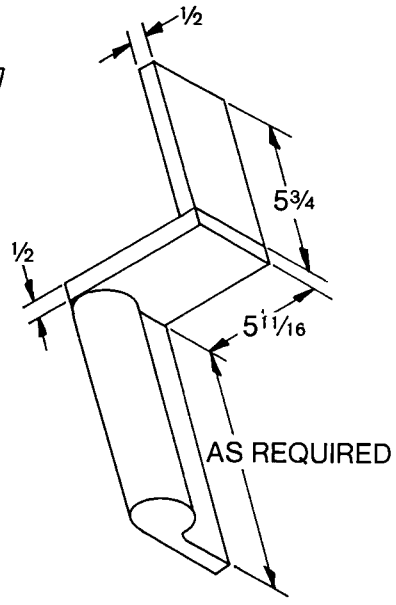
TYPICAL CROSS SECTION
PER MOLD NO. 5135 PG. K 2

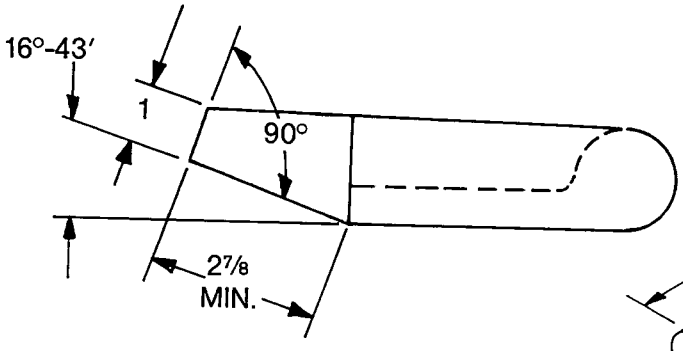
MOLD NO. 5120 & 5121
AS SHOWN AND OPPOSITE

MOLD NO. 4708 & 4709
AS SHOWN AND OPPOSITE

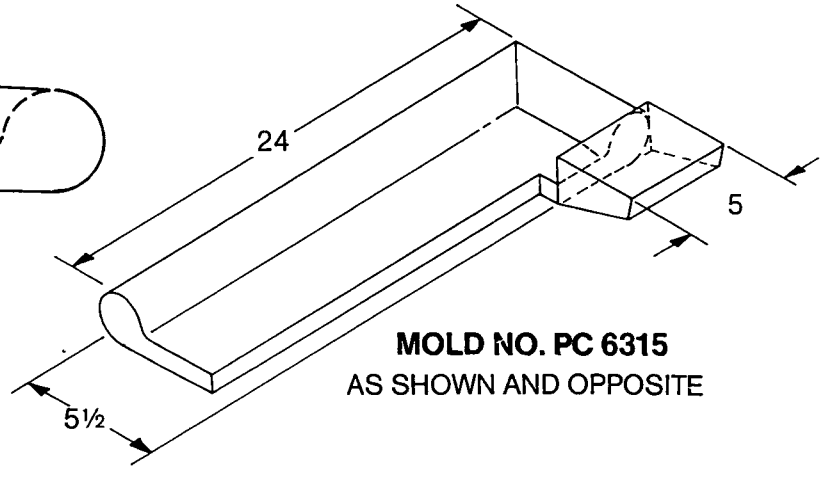
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514
4" MAX. WIDTH





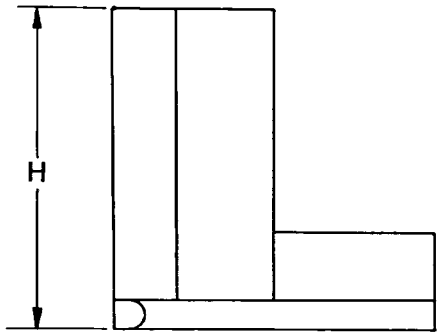


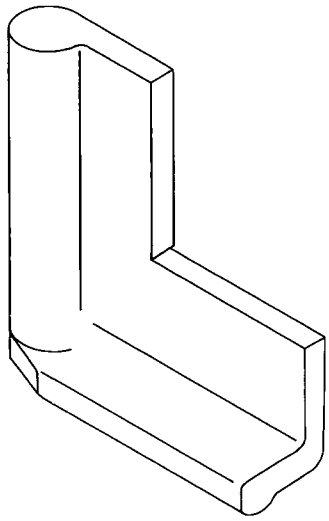
TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514
5" MAX. WIDTH



MOLD NO. PC 6315
AS SHOWN AND OPPOSITE

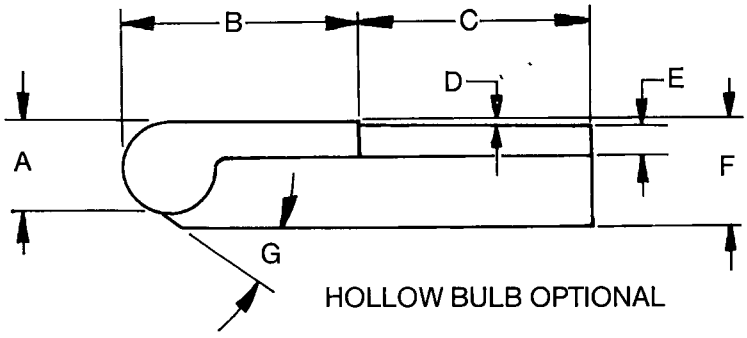
E-1



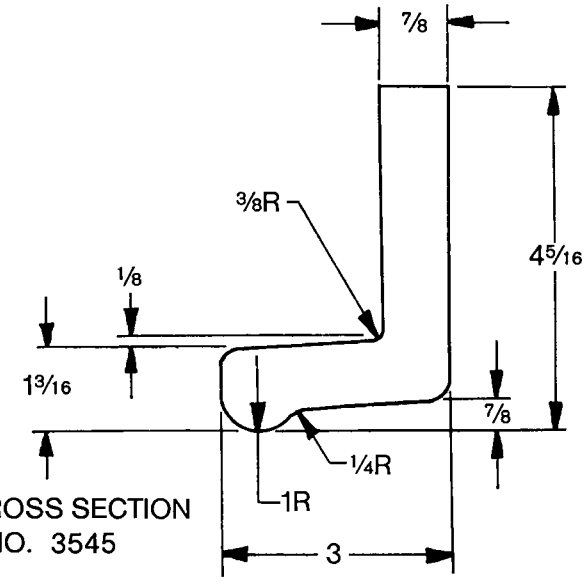


MOLD NO. 4527
MOLD NO. 4349 & 4350
MOLD NO. 5567 & 5568

AS SHOWN AND OPPOSITE

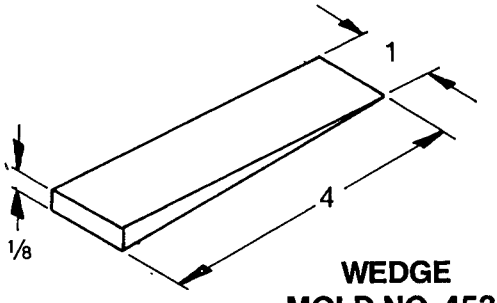


HOLLOW BULB OPTIONAL

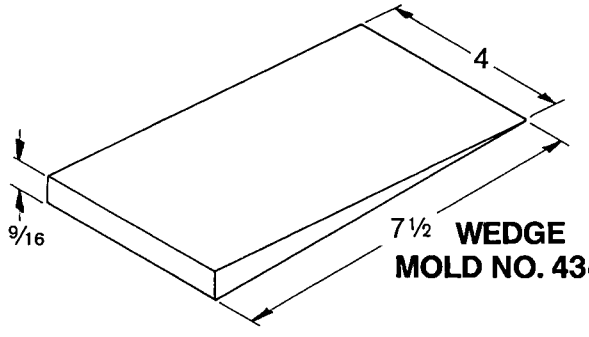


TYPICAL CROSS SECTION
MOLD NO. 3545

MOLD NO.	A	B	C	D	E	F	G	H
4349 & 4350	2	4 1/2	10 1/2	1/8	7/8	3	37°	15
4527	2 3/4	5 1/2	9 1/2	1/8	7/8	4 5/16	30°	15
5567 & 5568	2 3/4	7	8	1/8	7/8	3	30°	15



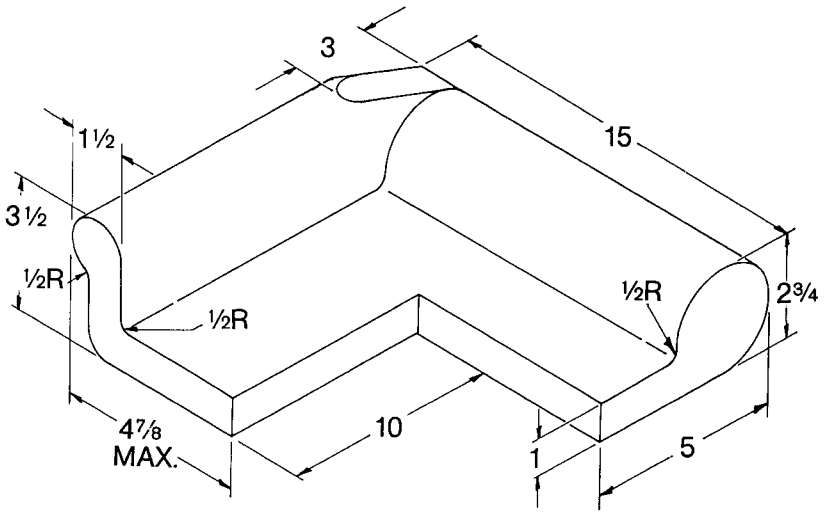
WEDGE
MOLD NO. 4537

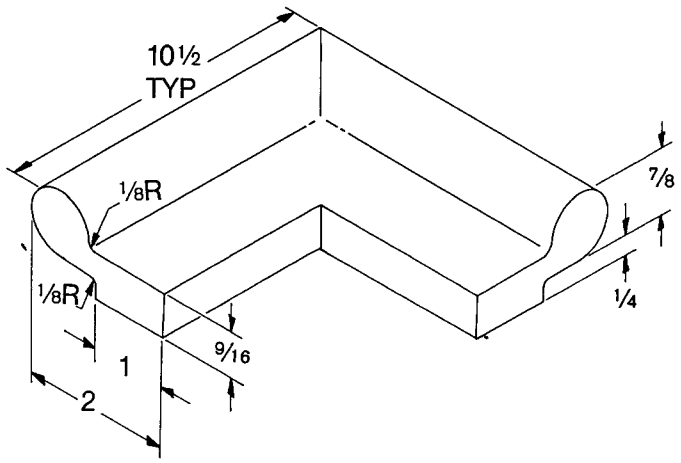


WEDGE
MOLD NO. 4348

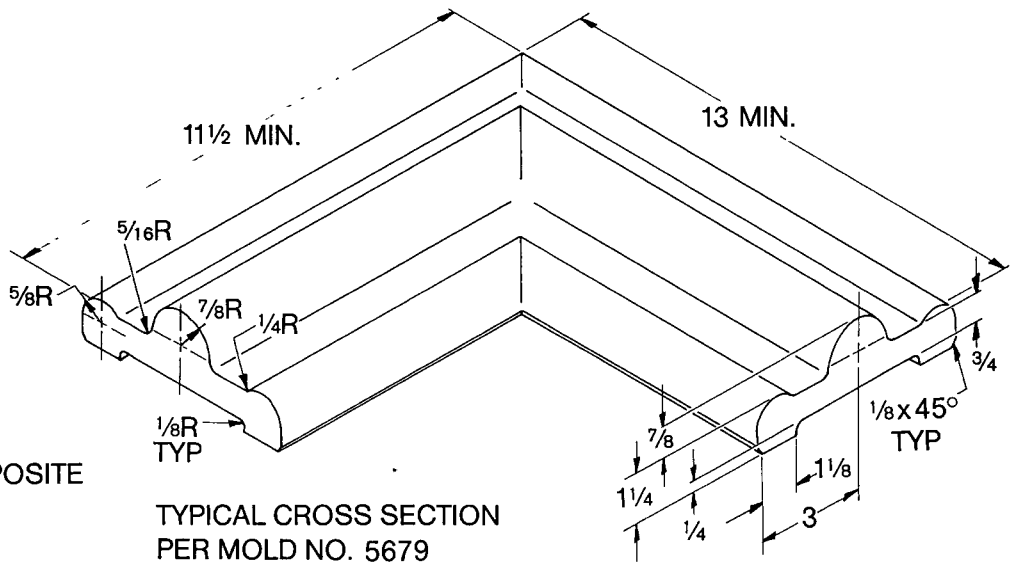
E-2

MOLD NO. 4724 & 4725
AS SHOWN AND OPPOSITE



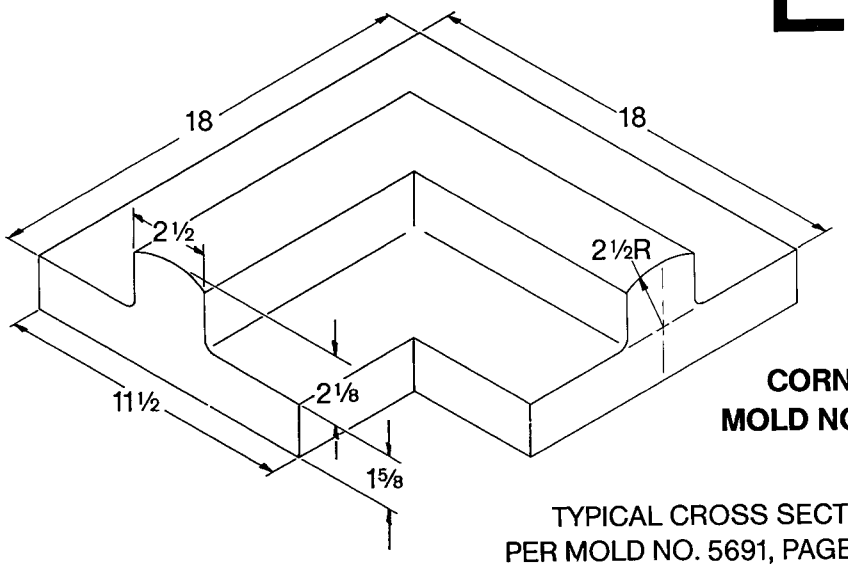


CORNER MOLD NO. 3761-1
STRIP MOLD NO. 3796-1



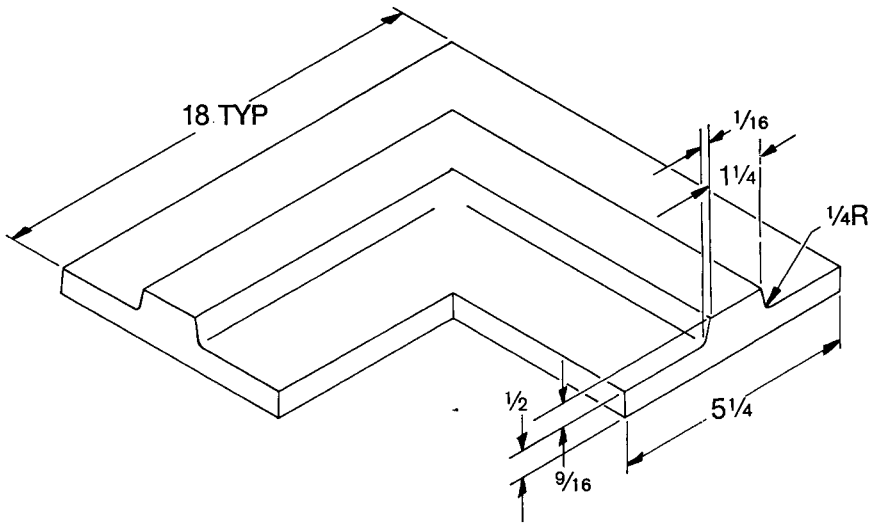
MOLD NO. 5681
AS SHOWN AND OPPOSITE

TYPICAL CROSS SECTION
PER MOLD NO. 5679



CORNER
MOLD NO. 5694

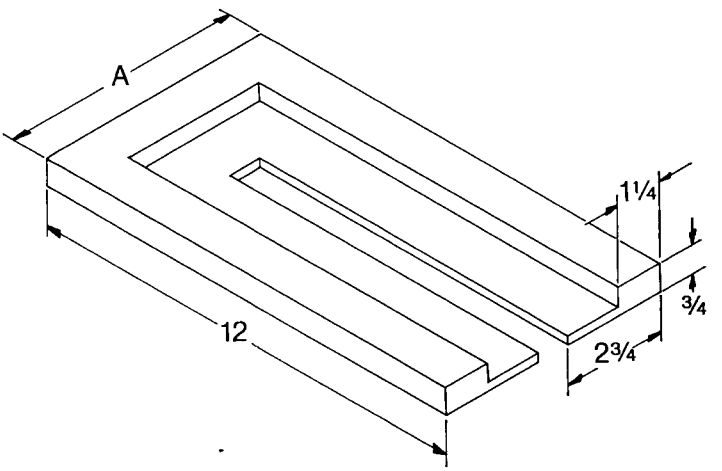
TYPICAL CROSS SECTION
PER MOLD NO. 5691, PAGE H-22



CORNER MOLD NO. 5068
STRIP MOLD NO. 3171

MOLD NO. A-15225
MOLD NO. 5538

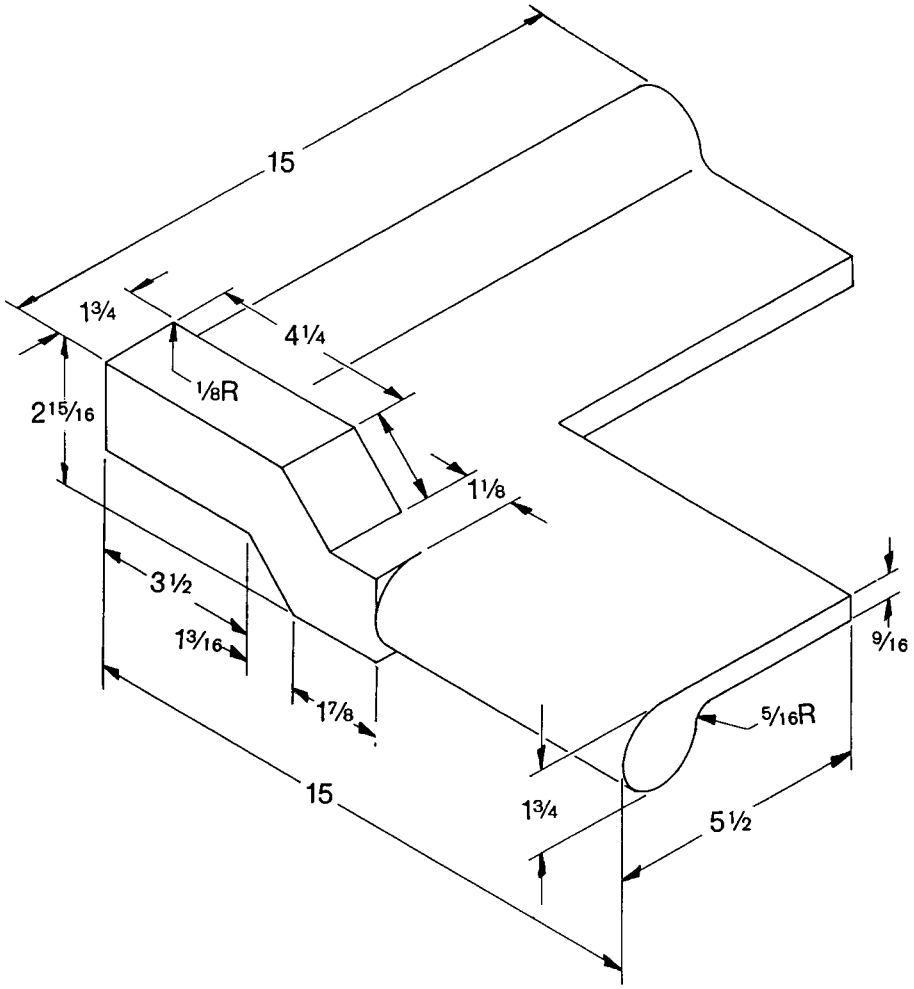
TYPICAL CROSS SECTION
MOLD NO. 3720
PAGE G-3

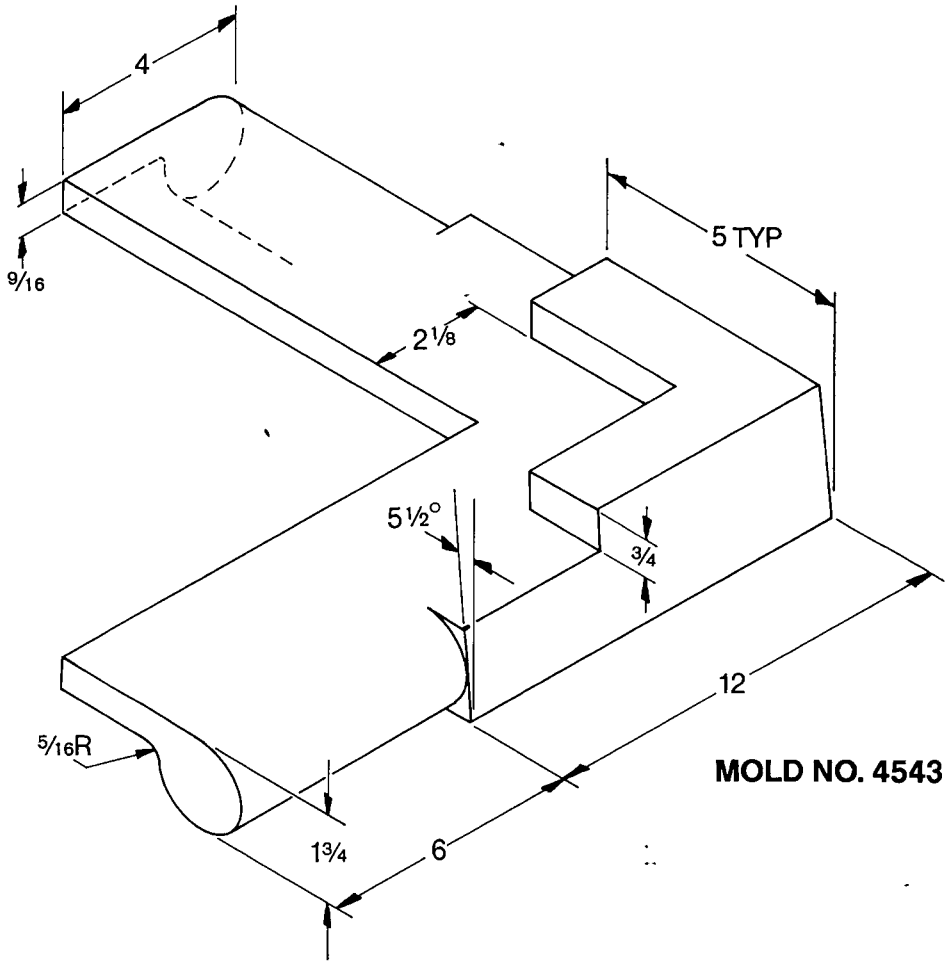


MOLD NO.	A
A 1 5225	6⅜
5538	9 5/16

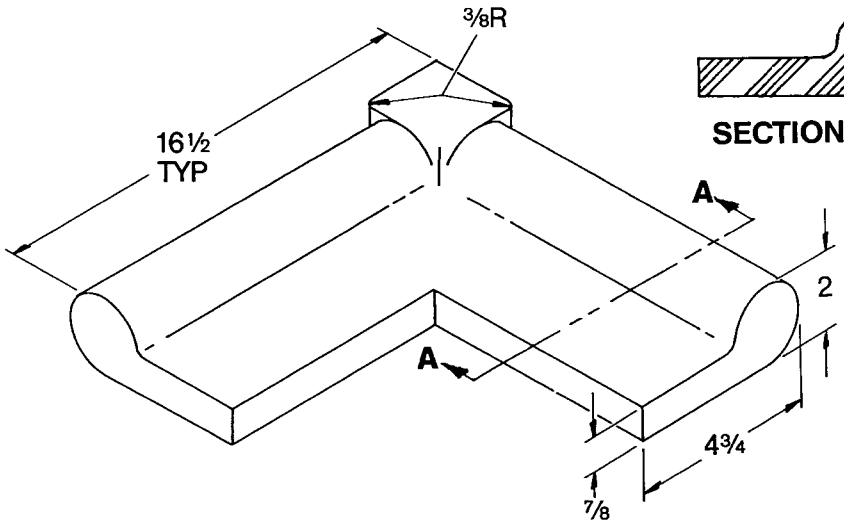
E-4

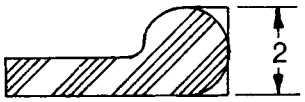
MOLD NO. 3506 & 3507
AS SHOWN AND OPPOSITE





MOLD NO. 4543

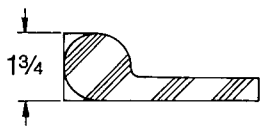




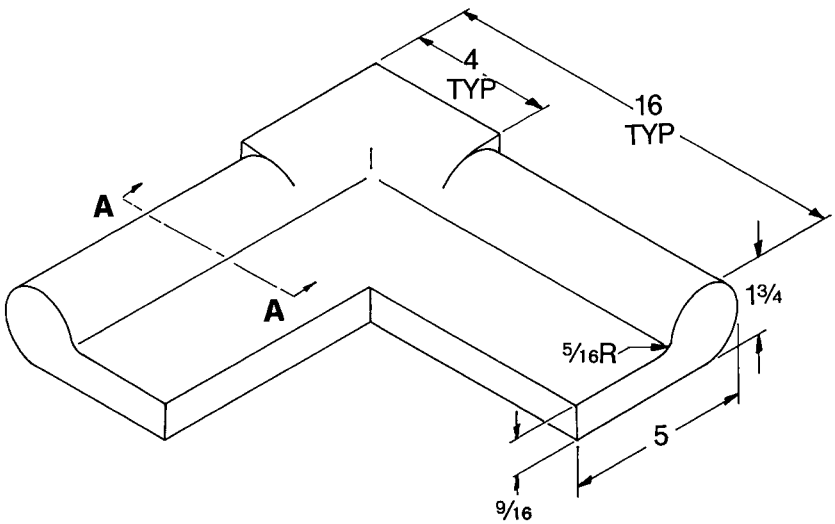
SECTION A-A

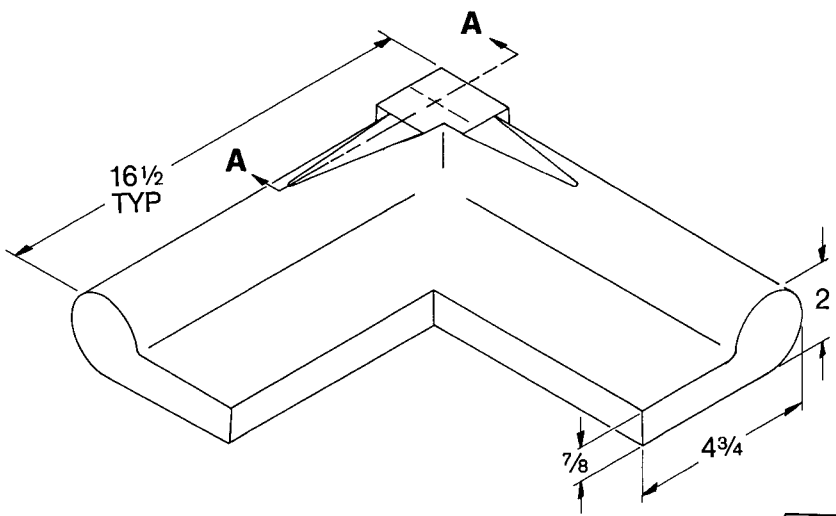
MOLD NO. 3375

MOLD NO. 4097

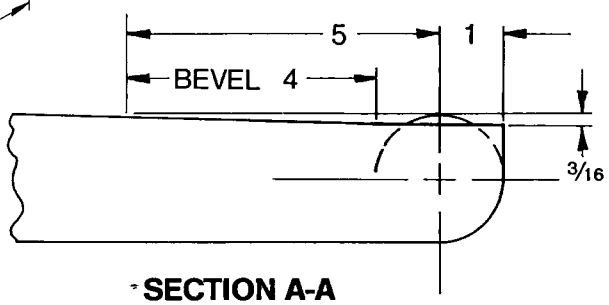


SECTION A-A

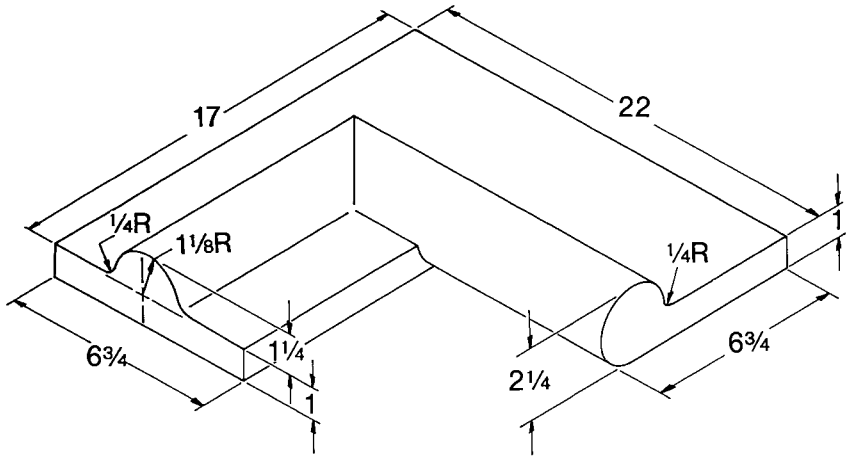




MOLD NO. 5137



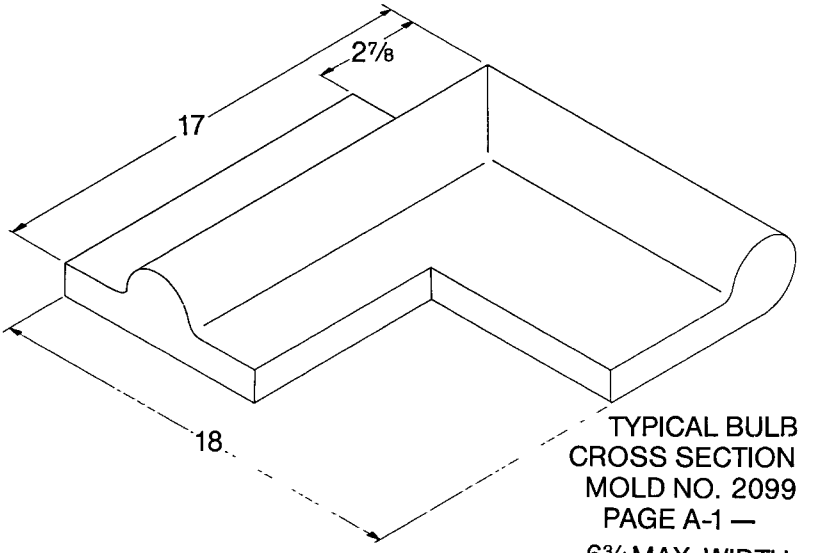
SECTION A-A



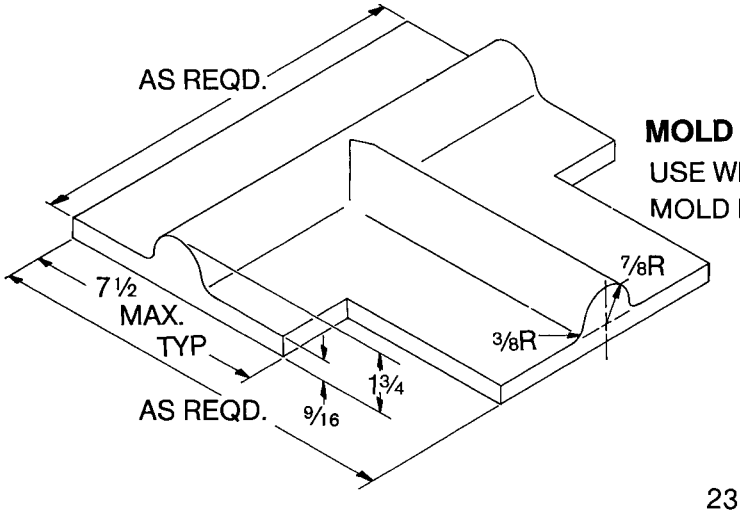
MOLD NO. 5596
AS SHOWN AND OPOSITE

MOLD NO. 5595
AS SHOWN AND OPPOSITE

TYPICAL CROSS SECTION
PER STRIP MOLD NO. 5569
PAGE H-22

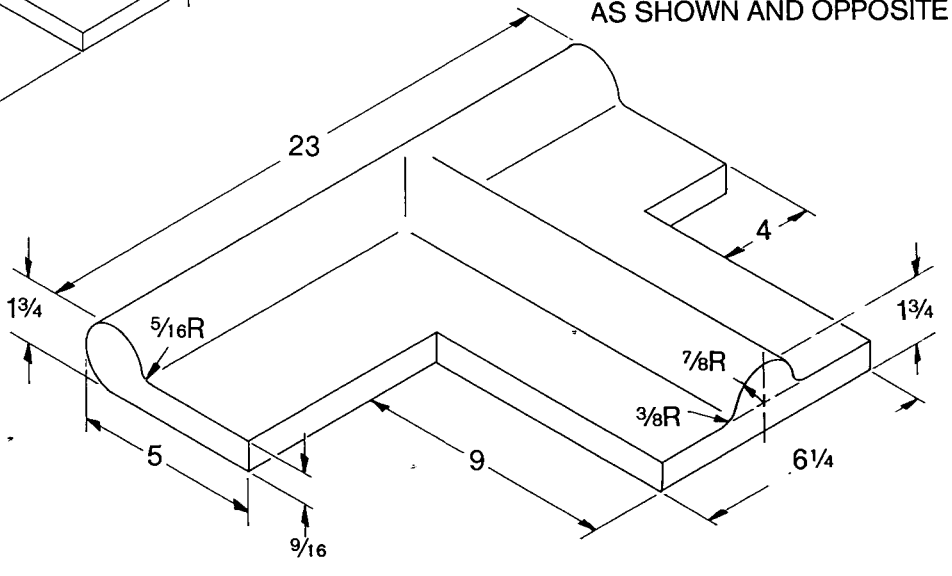


TYPICAL BULB
CROSS SECTION
MOLD NO. 2099
PAGE A-1 —
6 3/4 MAX. WIDTH

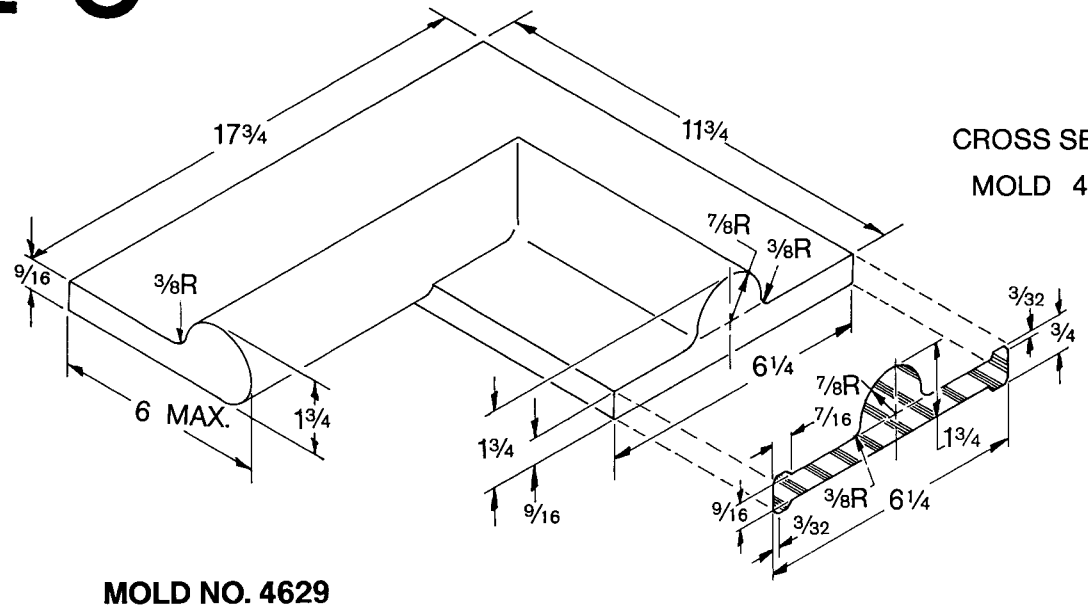


MOLD NO. 5583
USE WITH STRIP
MOLD No. 4767

MOLD NO. 4861
AS SHOWN AND OPPOSITE



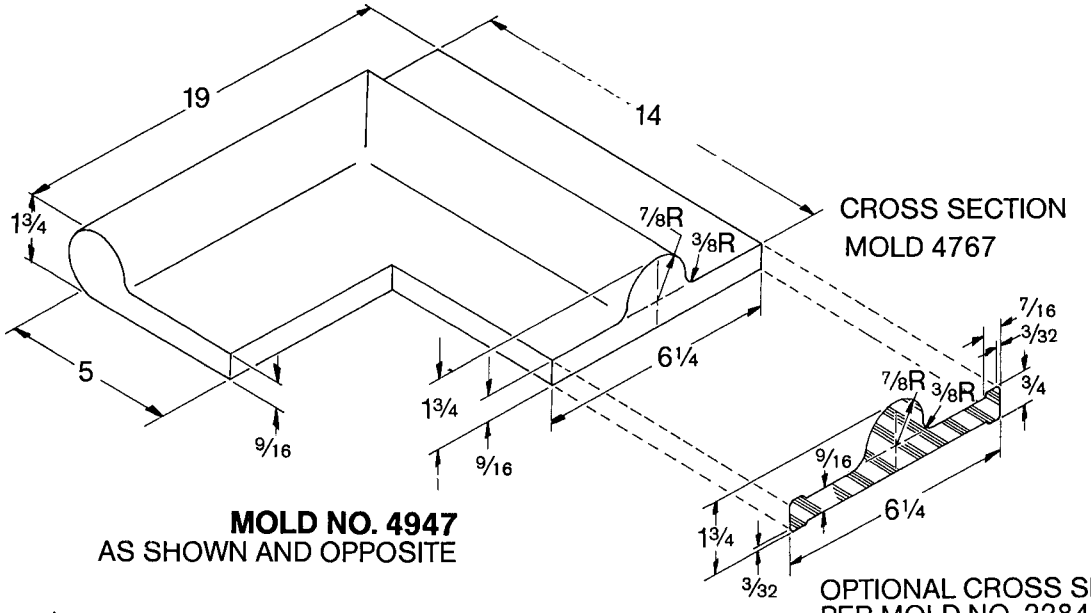
E-8



CROSS SECTION
MOLD 4767

MOLD NO. 4629
AS SHOWN AND OPPOSITE

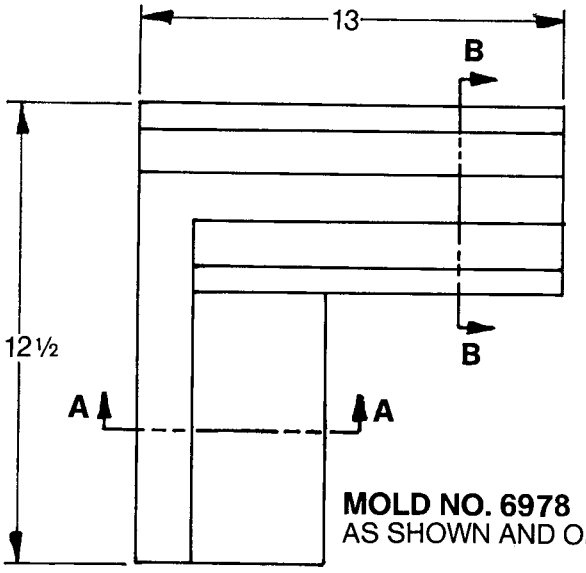
OPTIONAL CROSS SECTION
PER MOLD NO. 2284



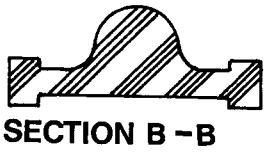
CROSS SECTION
MOLD 4767

MOLD NO. 4947
AS SHOWN AND OPPOSITE

OPTIONAL CROSS SECTION
PER MOLD NO. 2284

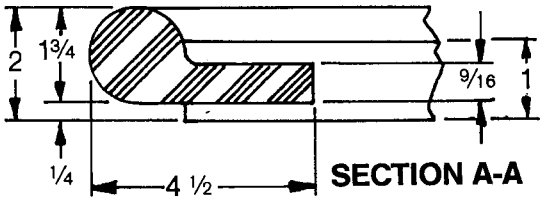


MOLD NO. 6978
AS SHOWN AND OPPOSITE

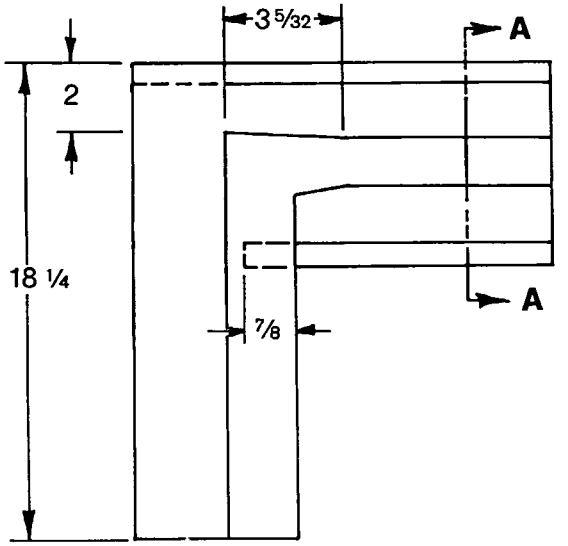


TYPICAL CROSS SECTION
MOLD 4499 PG. H–12

SECTION B–B

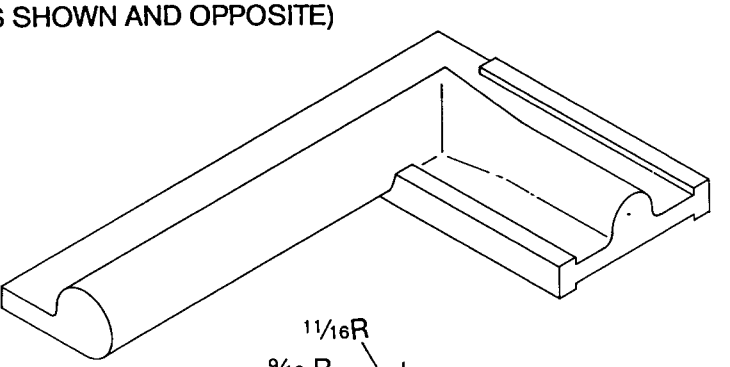


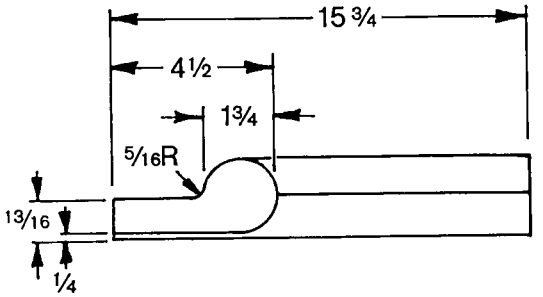
SECTION A-A

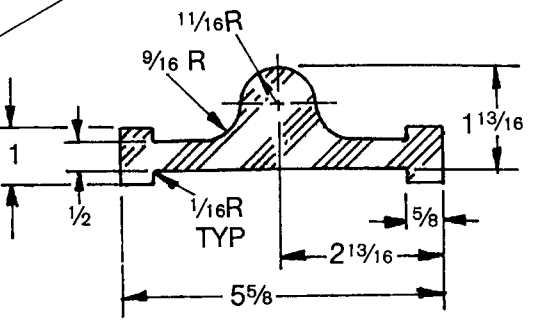


MOLD NO. 6809

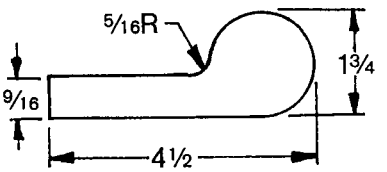
(AS SHOWN AND OPPOSITE)



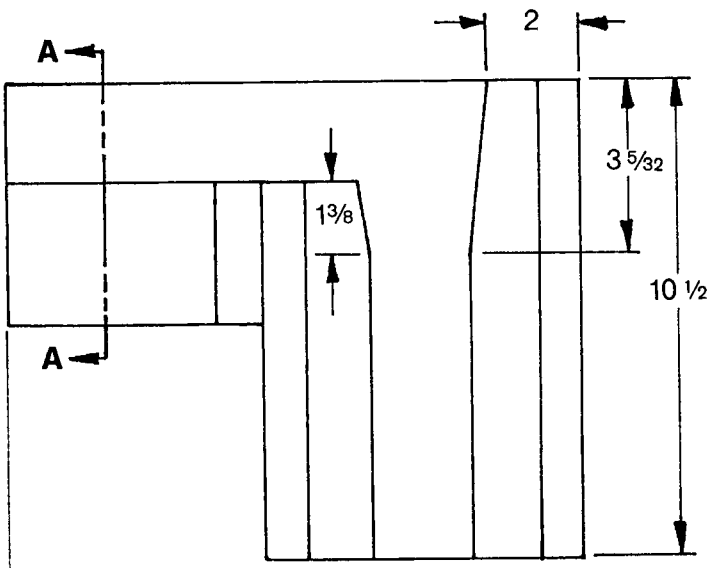


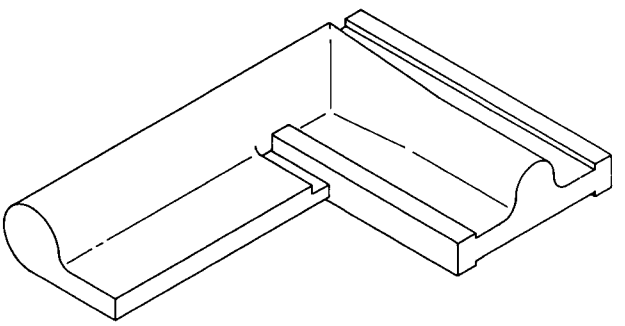


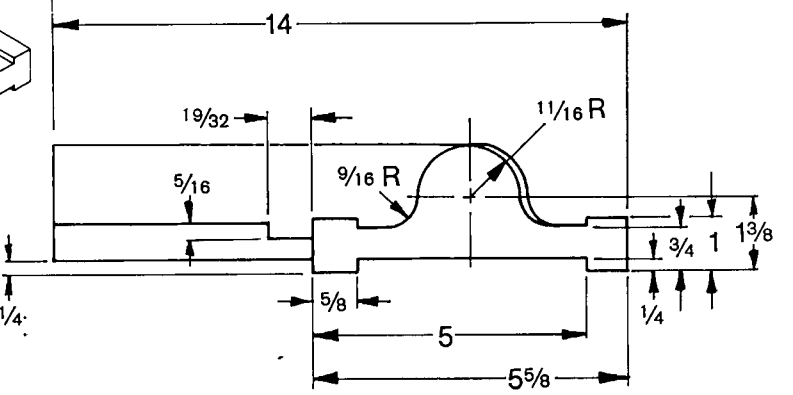
SECTION A-A



SECTION A-A



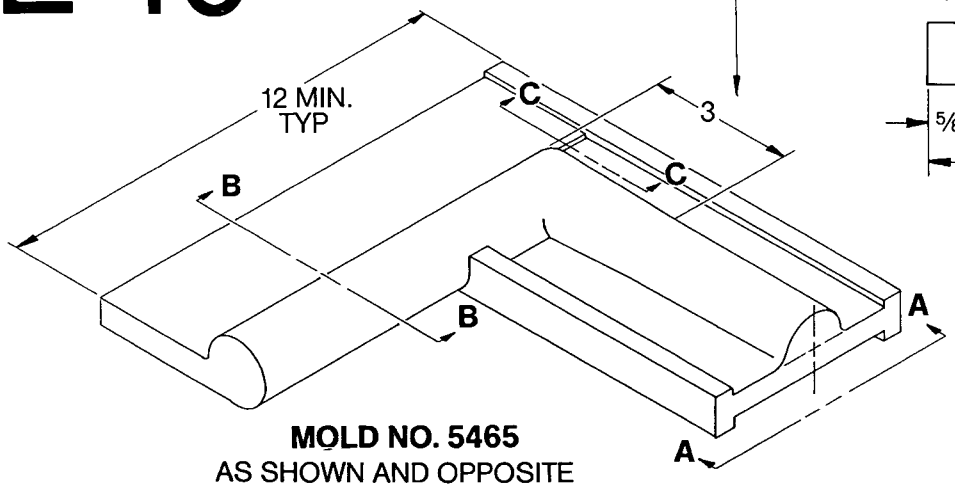




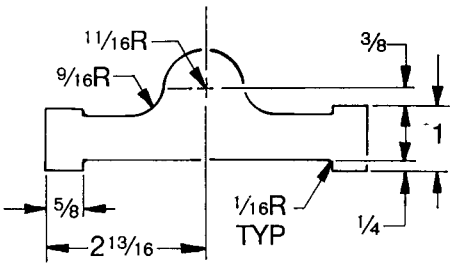
MOLD NO. 6810

(AS SHOWN AND OPPOSITE)

E-10

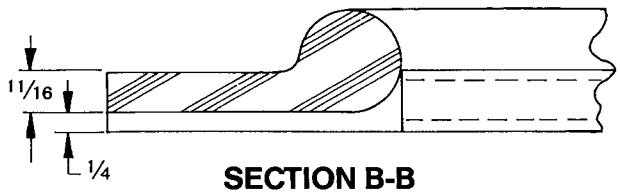


MOLD NO. 5465
AS SHOWN AND OPOSITE

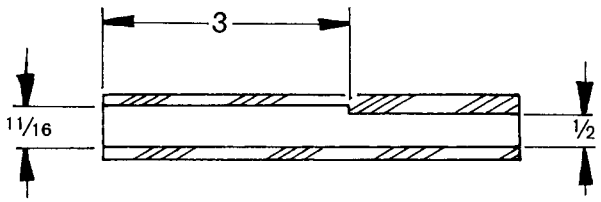


SECTION A-A
TYPICAL CROSS SECTION
PG. H-12, MOLD NO. 4499

TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2767

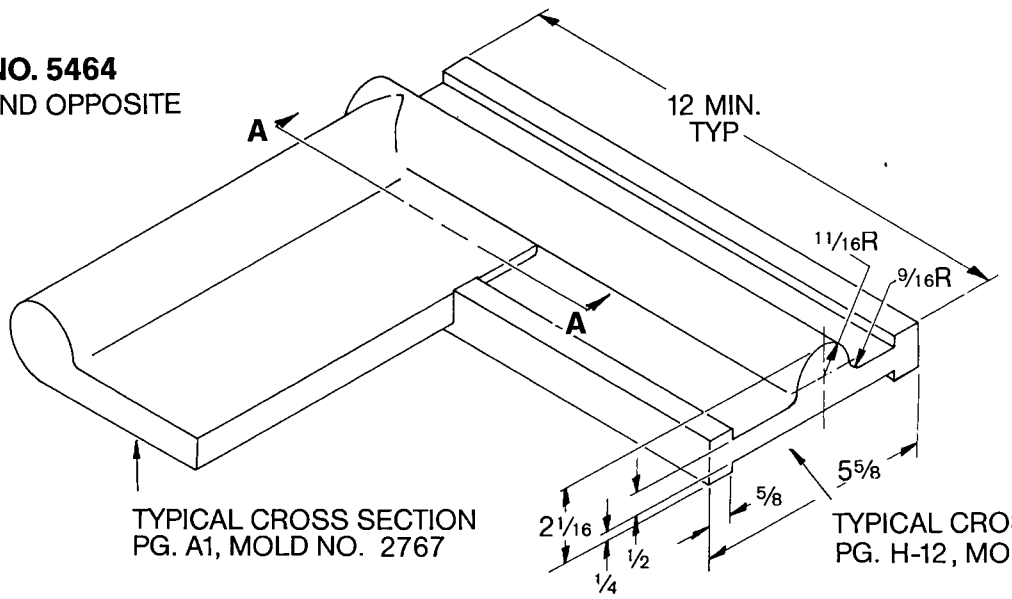


SECTION B-B



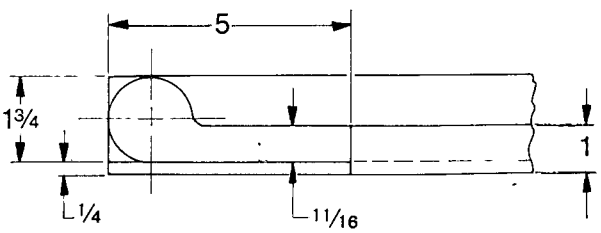
SECTION C-C

MOLD NO. 5464
AS SHOWN AND OPPOSITE

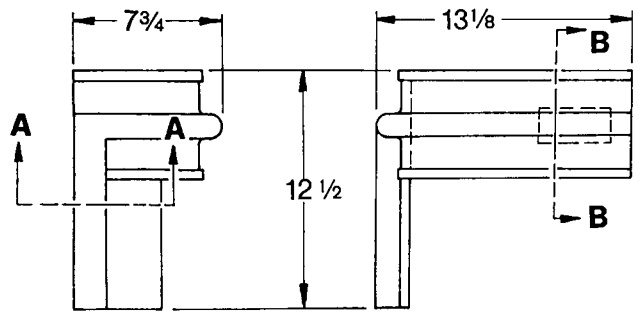


TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2767

TYPICAL CROSS SECTION
PG. H-12, MOLD NO. 4499

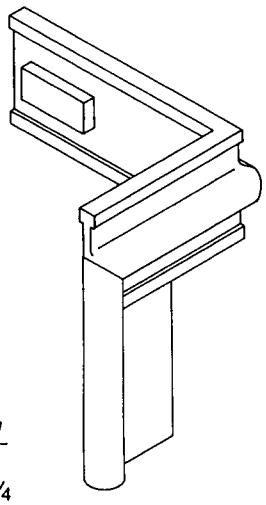


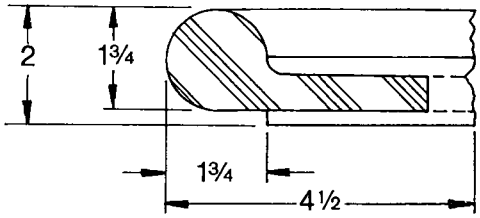
SECTION A-A



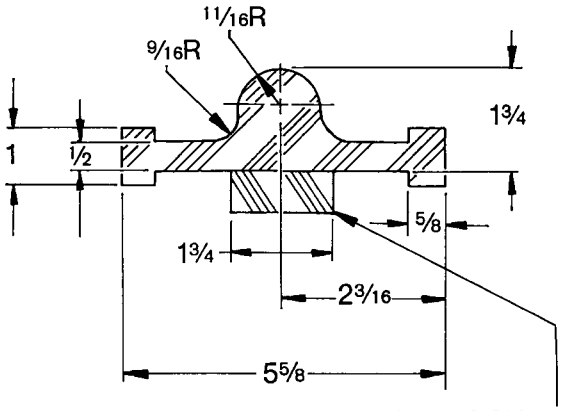
MOLD NO. 6979 & 6980
AS SHOWN AND OPPOSITE

USE WITH
MOLD NO. 4499



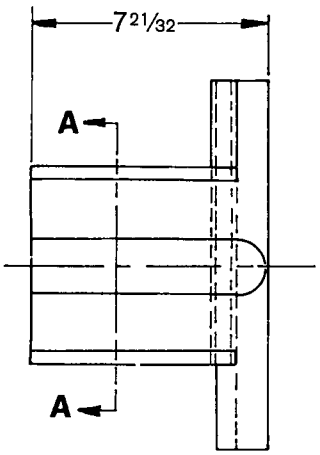


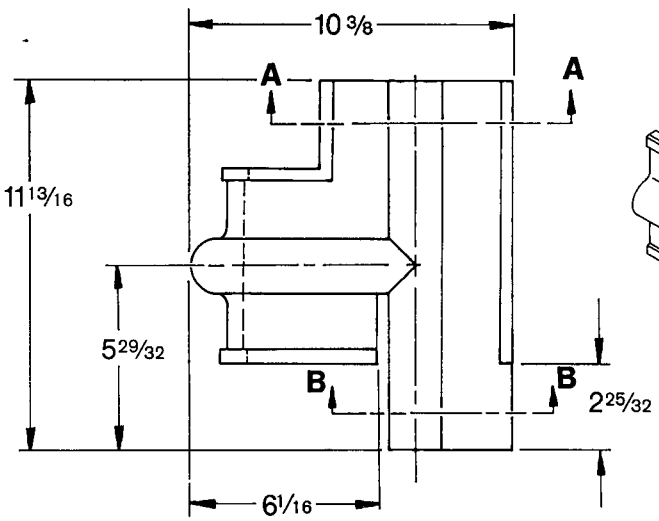
SECTION A-A

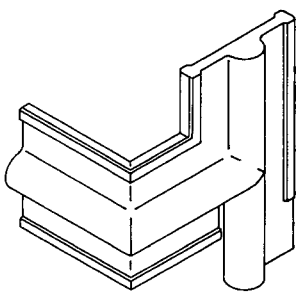


SECTION B-B

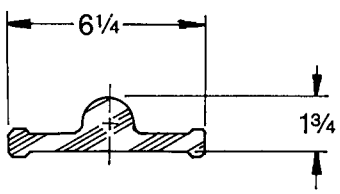
RUBBER BLOCK ¾ THICK x 1¾ x 3¾
VULCANIZED TO BACK OF TOP SEAL





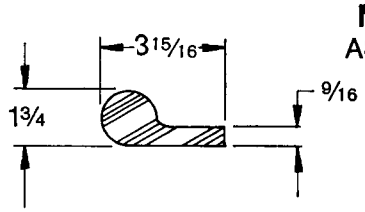


MOLD NO. 7001 & 7002
AS SHOWN AND OPPOSITE



TYPICAL CROSS SECTION
SEE MOLD NO. 2284, PAGE H-8

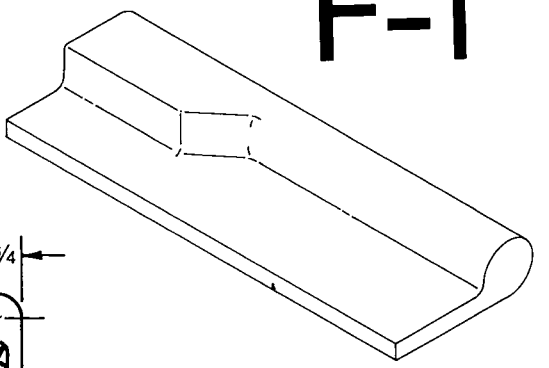
SECTION A-A

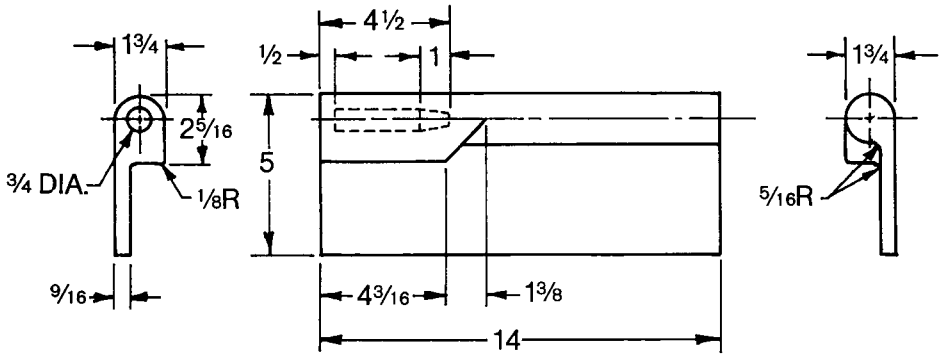


TYPICAL CROSS SECTION
PG. A1, MOLD NO. 2514

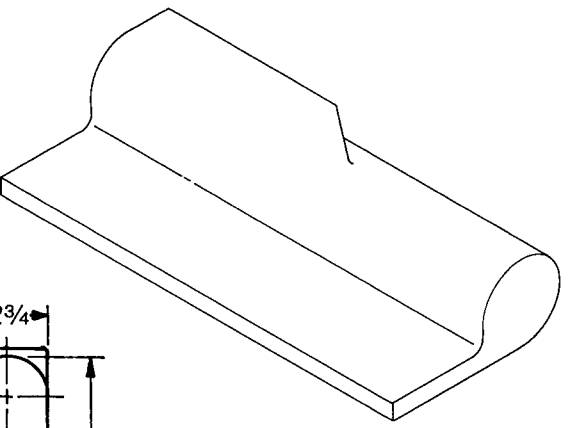
SECTION B-B

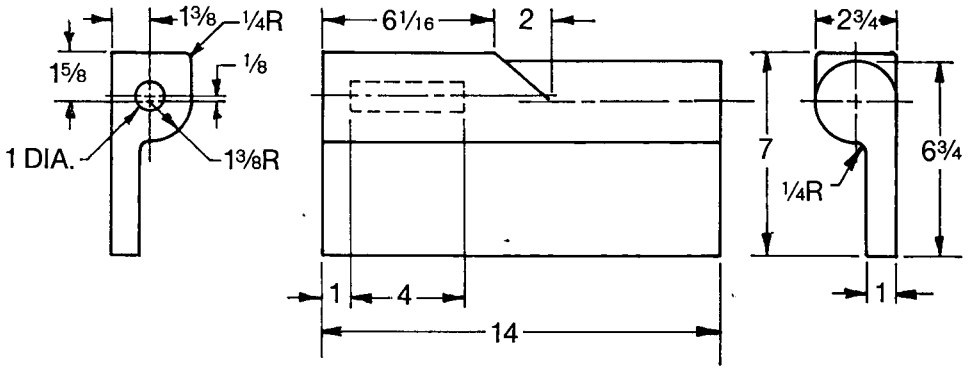
F-1



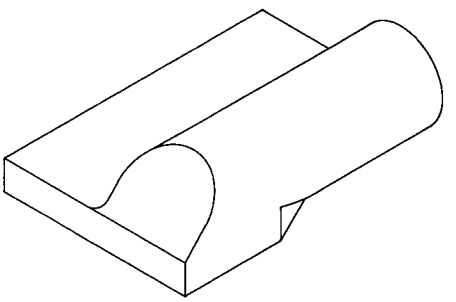


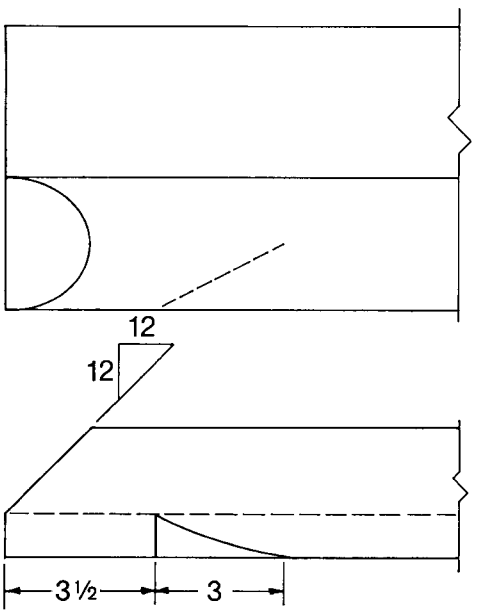
MOLD NO. 4487
AS SHOWN AND OPPOSITE



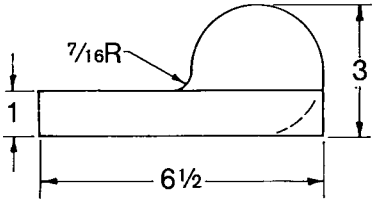


MOLD NO. 4488
AS SHOWN AND OPPOSITE



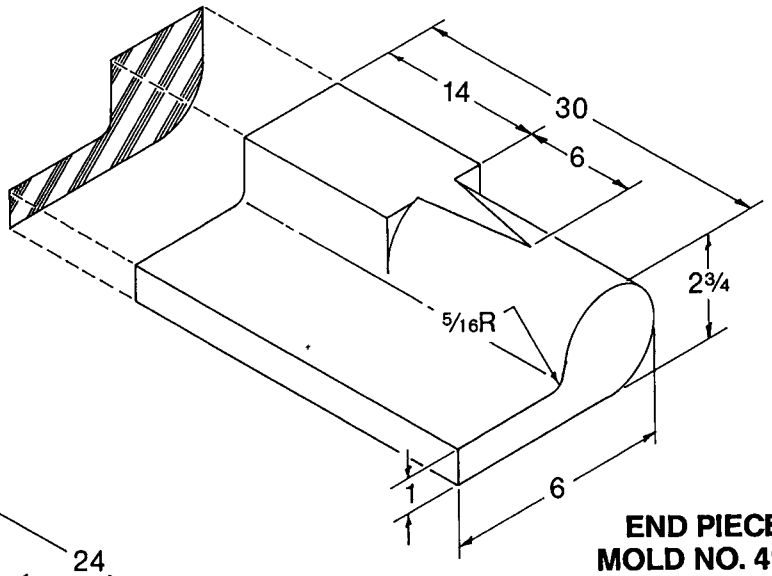


SPECIAL END PIECE
FOR ATTACHMENT TO MOLD NO. 3074 PAGE A-1

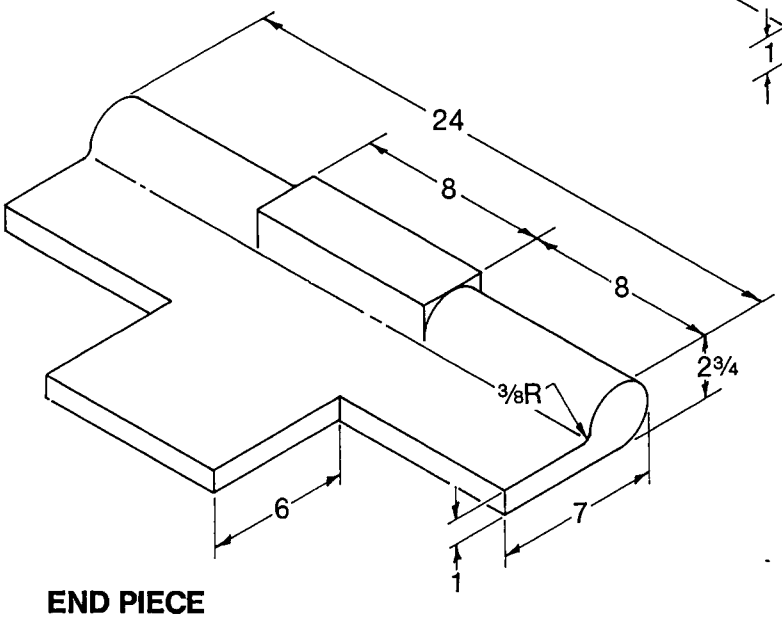


TYPICAL CROSS SECTION

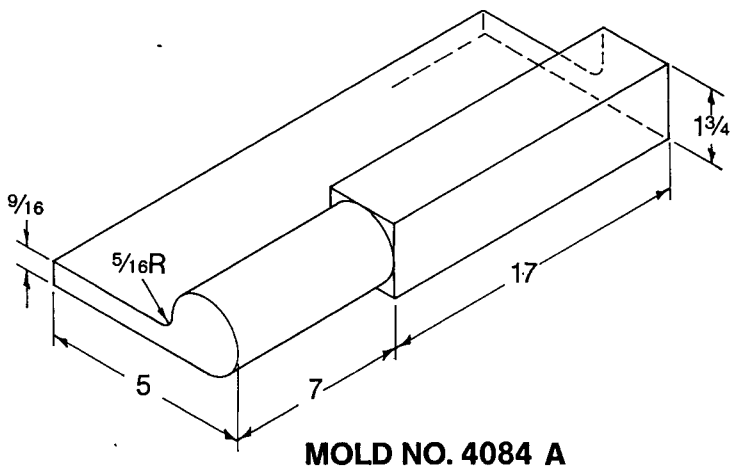
F-2



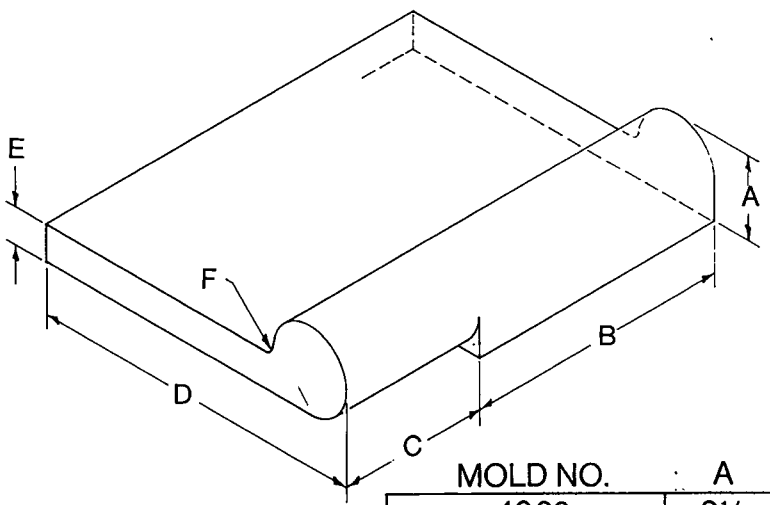
END PIECE
MOLD NO. 4992
AS SHOWN AND OPPOSITE



END PIECE
MOLD NO. 4665



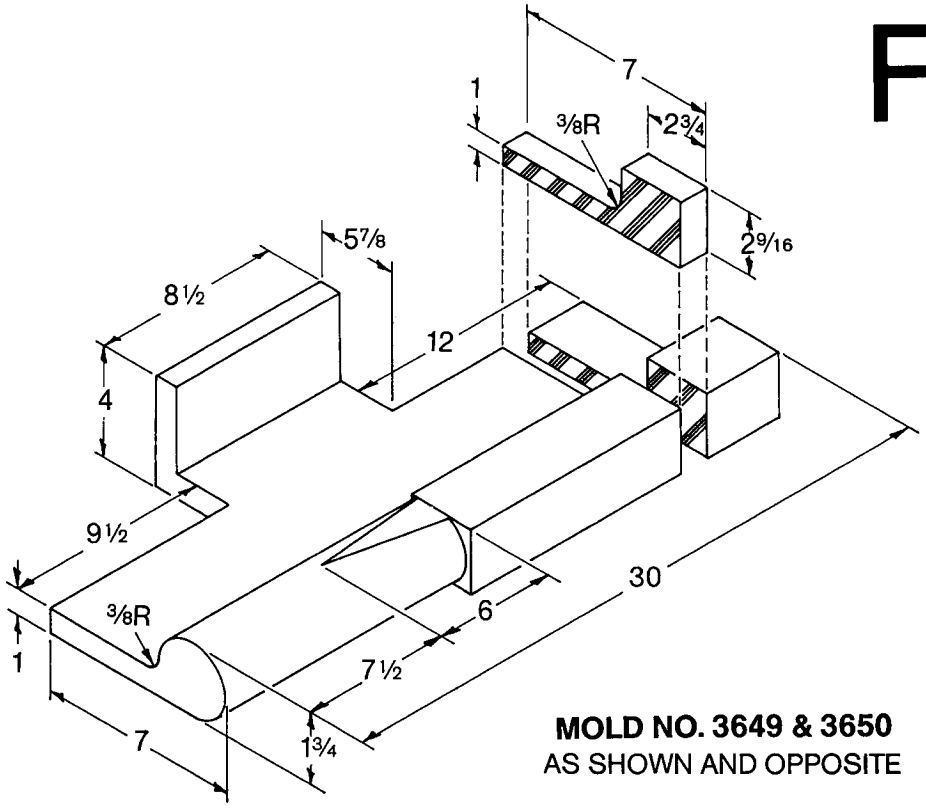
MOLD NO. 4084 A
AS SHOWN AND OPPOSITE



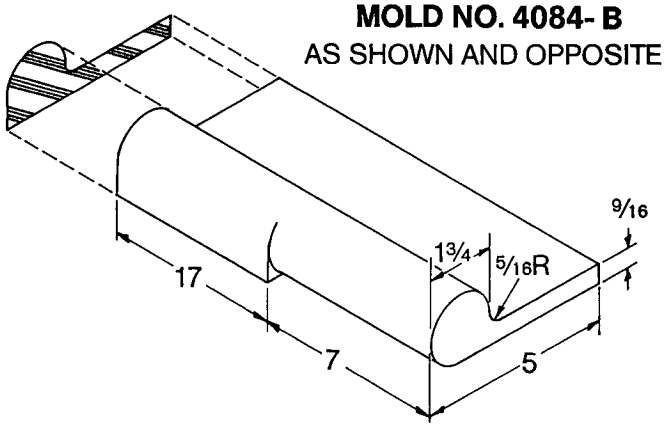
MOLD NO.	A	B	C	D	E	R
4083	2¼	12 ¾	5½	9	1	¼R
*	1¾	5	***	6	⅞	5/16R

***AS REQUIRED * FOR USE WITH MOLD NO. 2575 PAGE A-1

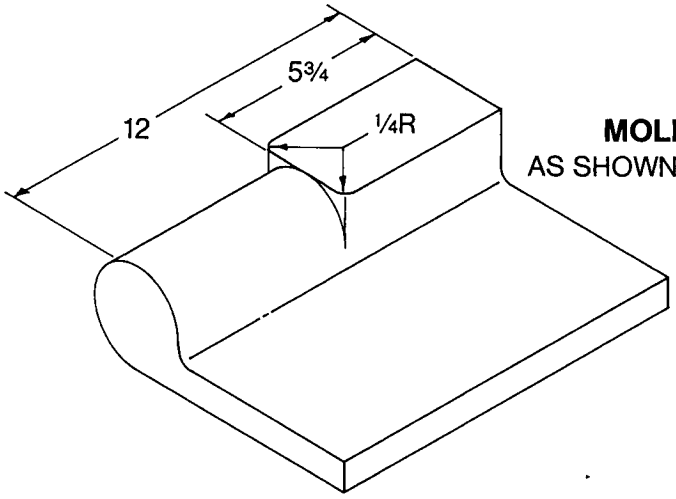
F-3



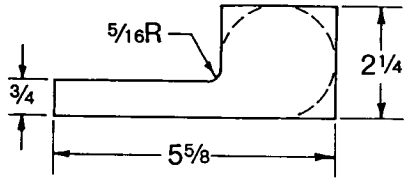
MOLD NO. 3649 & 3650
AS SHOWN AND OPPOSITE



MOLD NO. 4084- B
AS SHOWN AND OPPOSITE

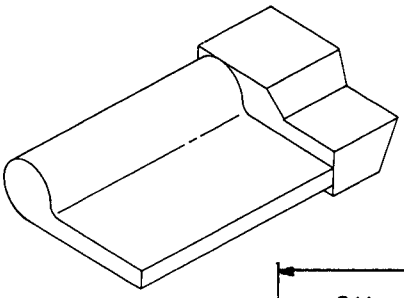


MOLD NO. 3441
AS SHOWN AND OPPOSITE

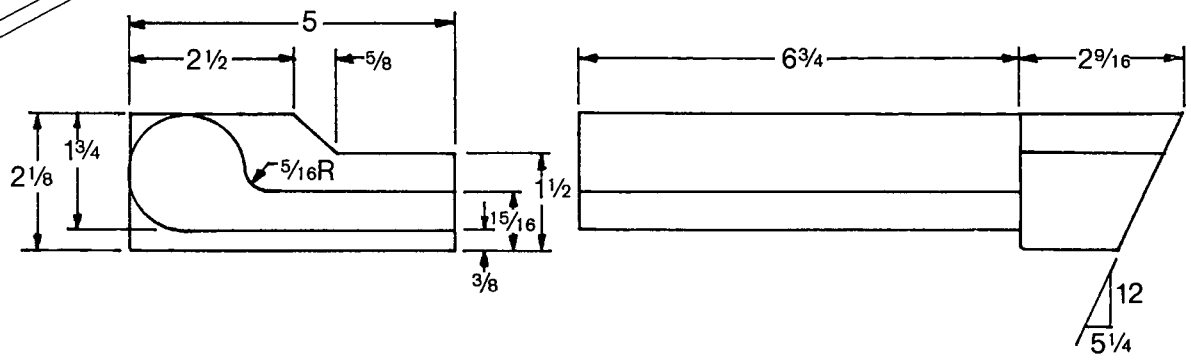


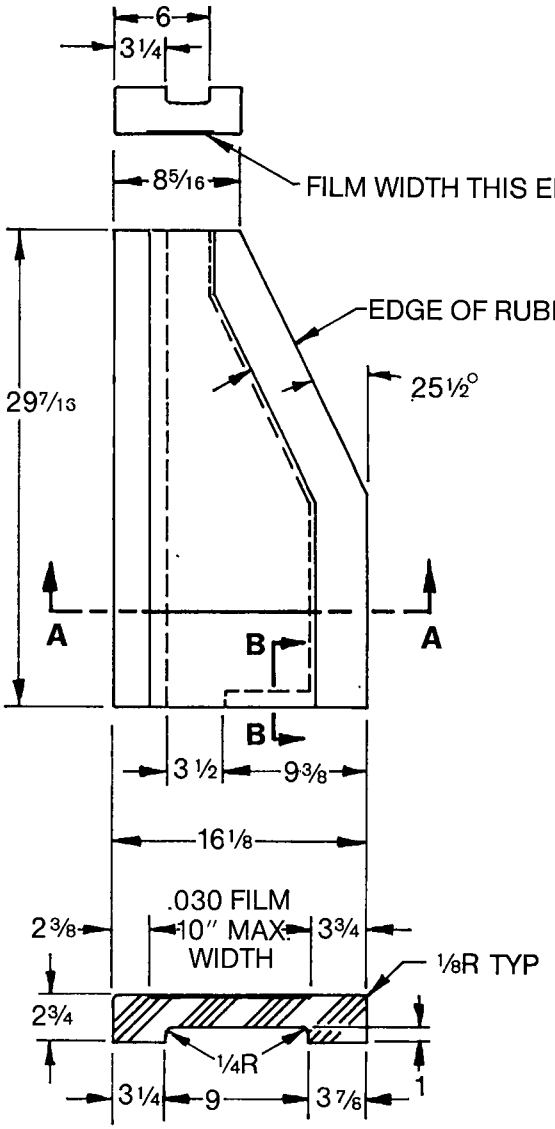
TYPICAL CROSS SECTION

F-4

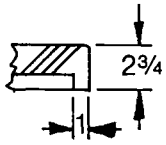


END PIECE
MOLD NO. 6475
AS SHOWN AND OPPOSITE





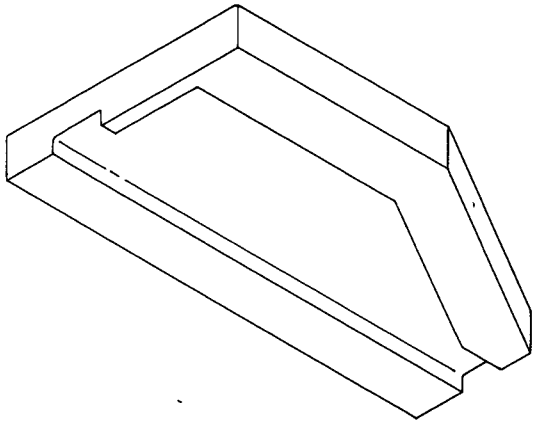
SECTION A-A

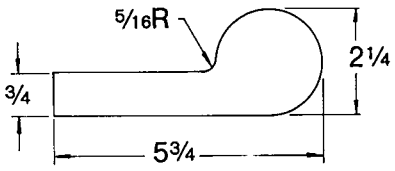


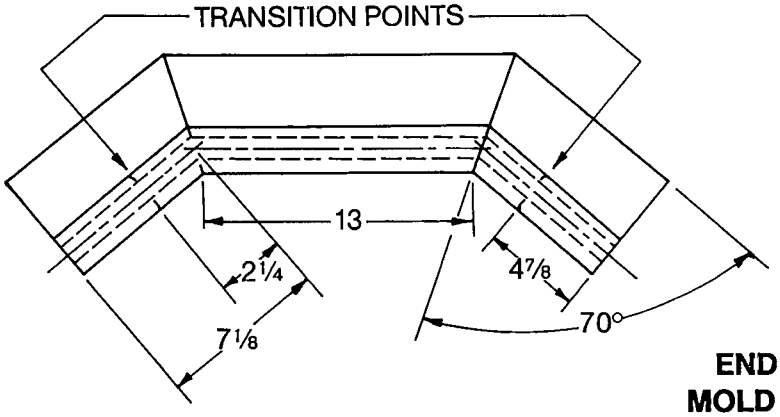
SECTION B-B

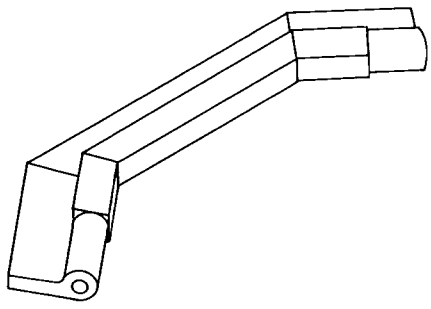
MOLD NO. 5298 & 5299
AS SHOWN AND OPPOSITE

FLUORO-CARBON FILM
COVER (OPTIONAL)
USED WITH MOLD NO. 3677-A



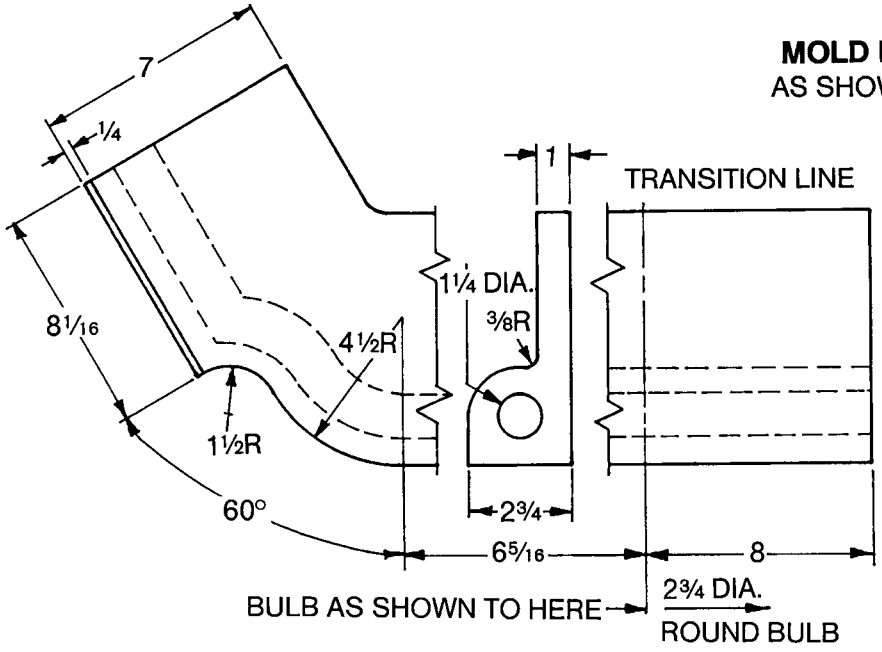


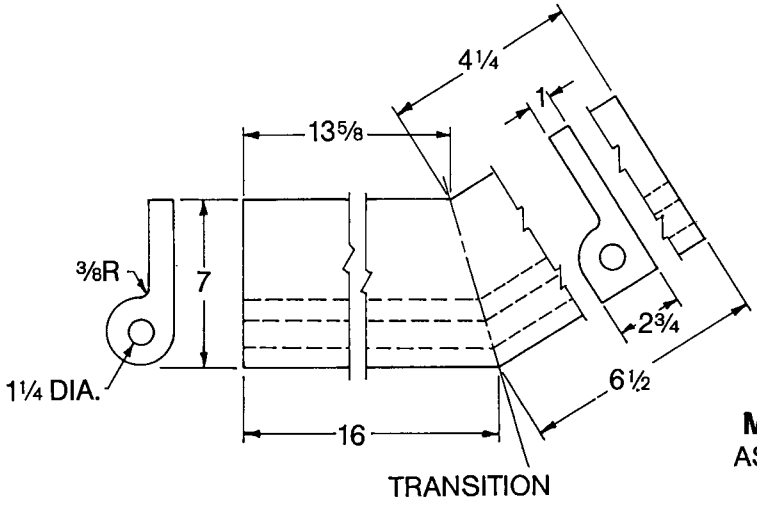


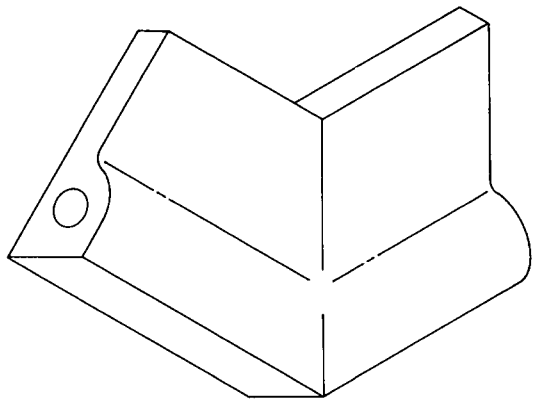


END PIECE
MOLD NO. 4240
FOR USE WITH MOLD NO. 4234 & 4235

MOLD NO. 3533 & 3534
AS SHOWN AND OPPOSITE



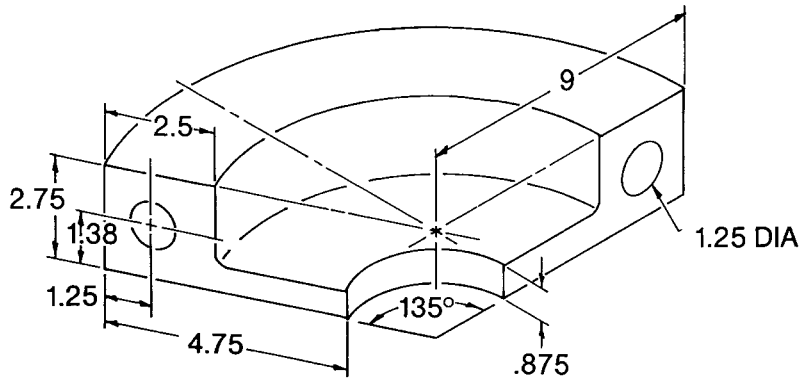


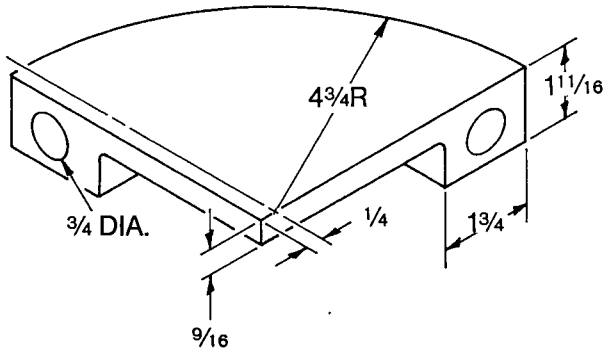


MOLD NO. 3536 & 3537
AS SHOWN AND OPPOSITE

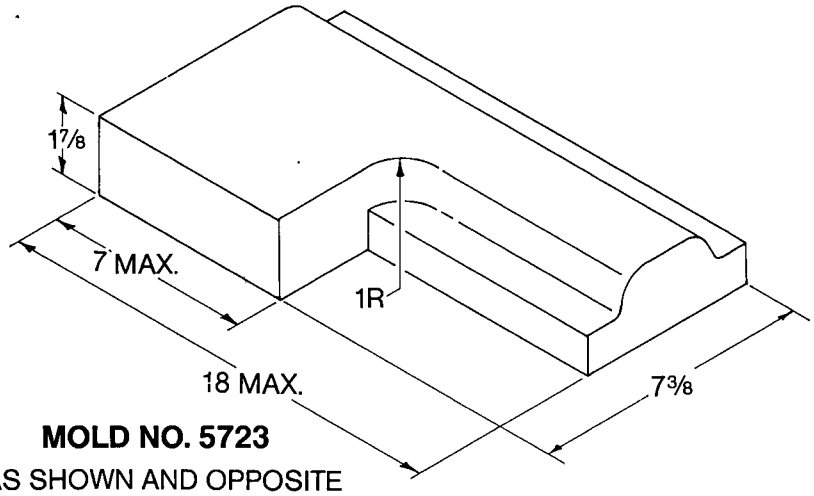
F-6

MOLD NO. 5226



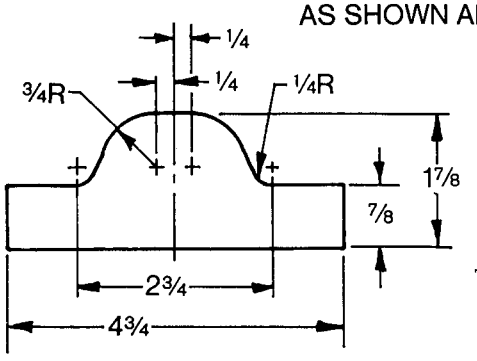


MOLD NO. 5050

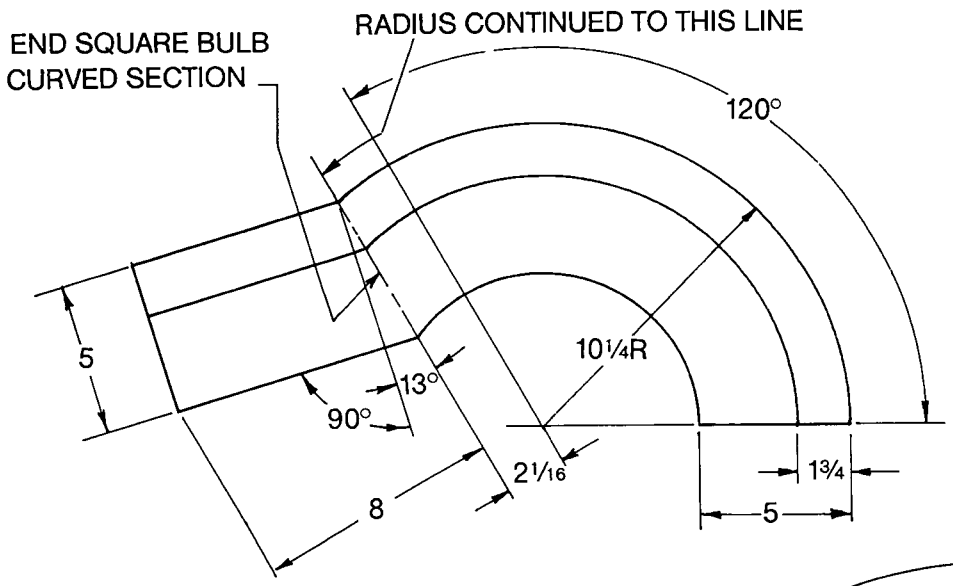


MOLD NO. 5723

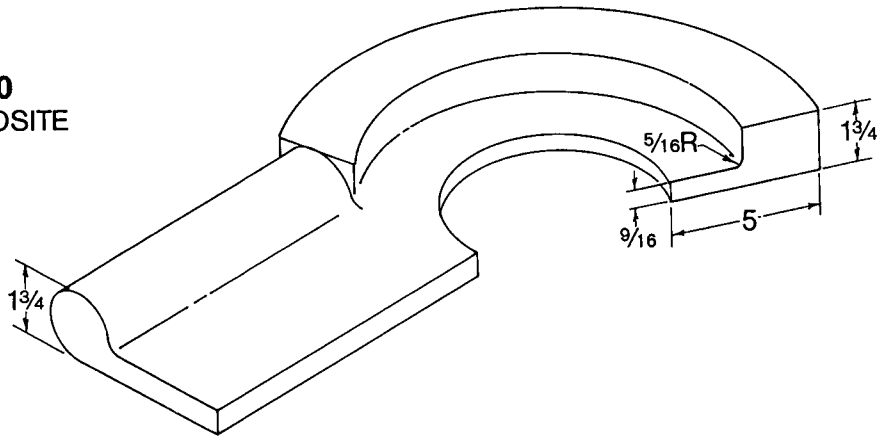
AS SHOWN AND OPPOSITE



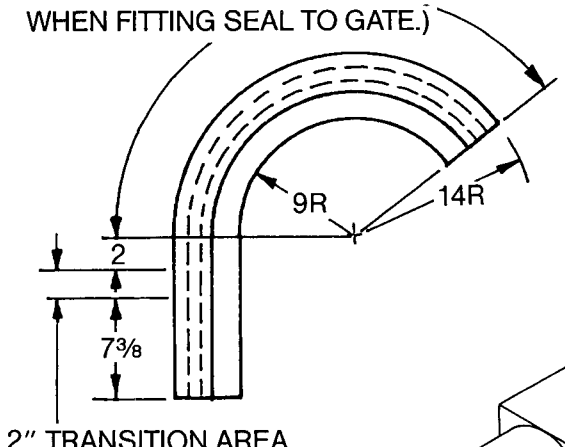
CROSS SECTION
MOLD NO.3621



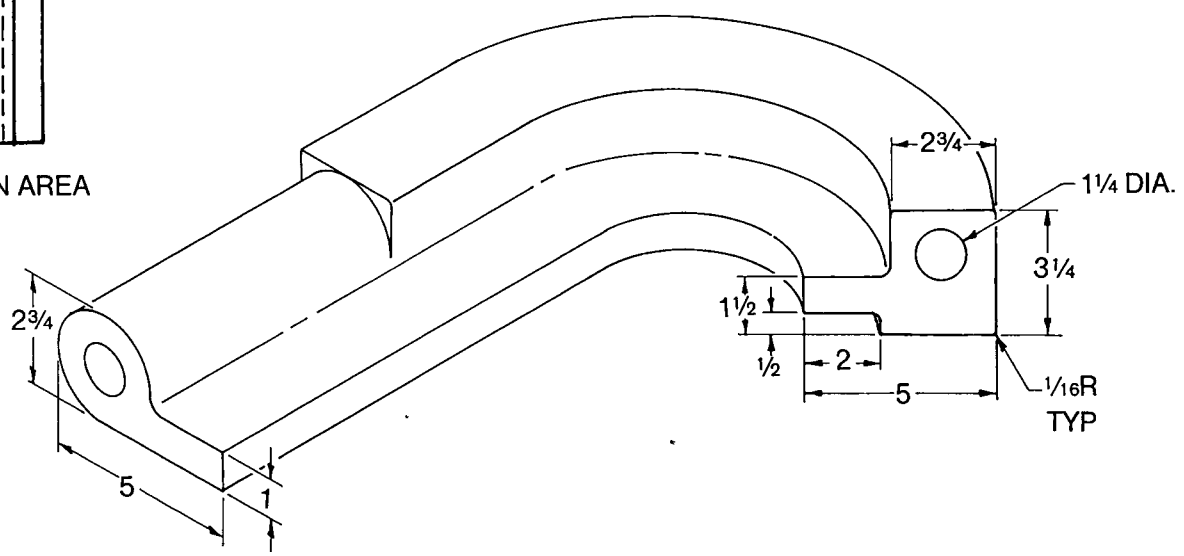
MOLD NO. 5910
AS SHOWN AND OPPOSITE

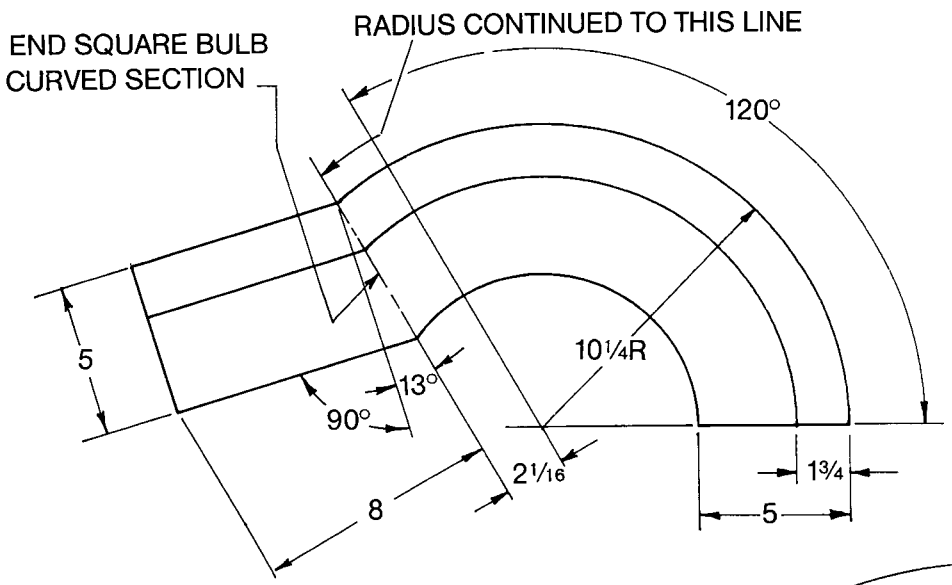


24⁹⁄₁₆" ON 10" RADIUS BOLT CIRCLE (WITHOUT BOLT HOLES—BOLT HOLES TO BE DRILLED WHEN FITTING SEAL TO GATE.)

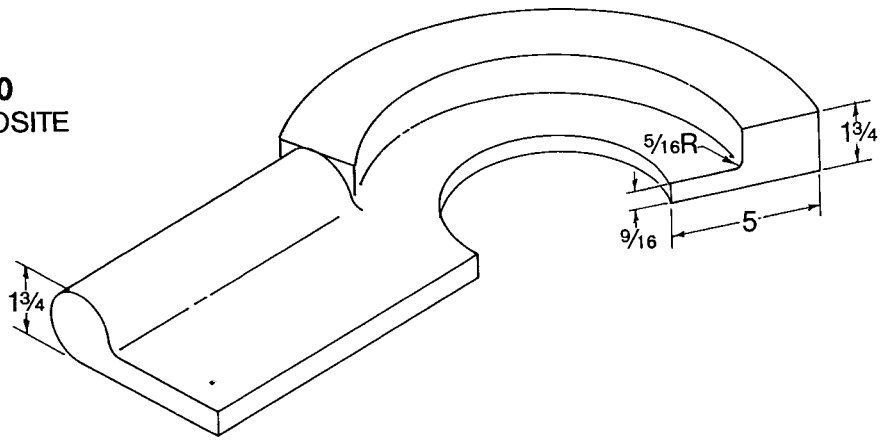


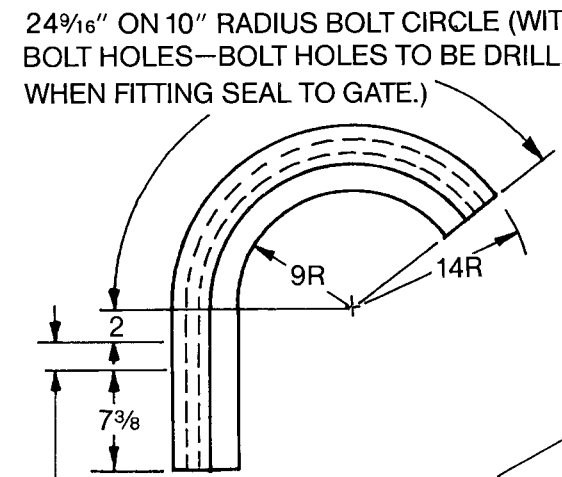
MOLD NO. 4308
AS SHOWN AND OPPOSITE



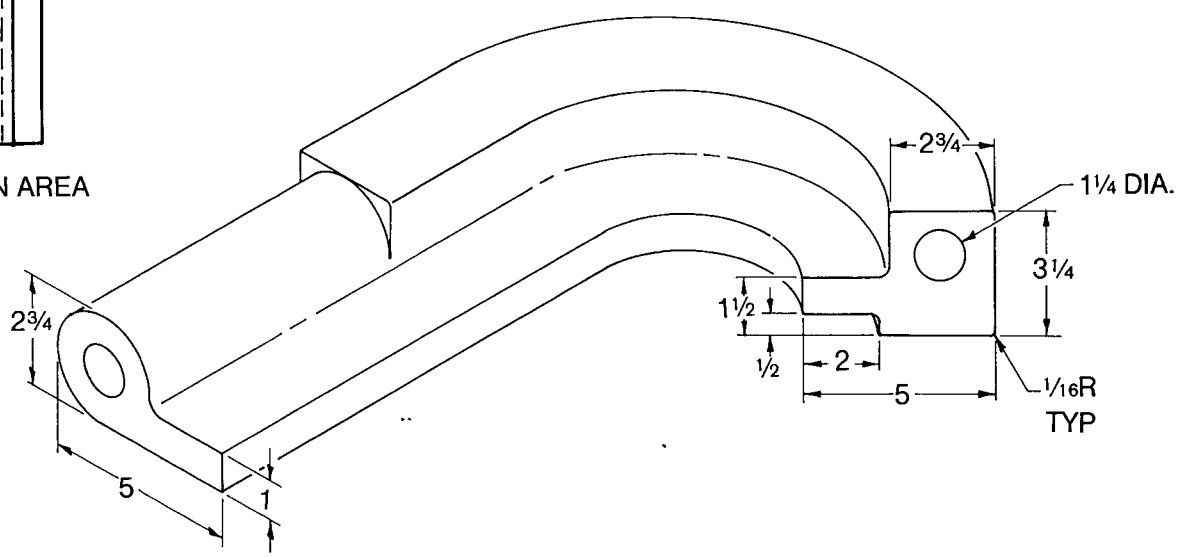


MOLD NO. 5910
AS SHOWN AND OPPOSITE

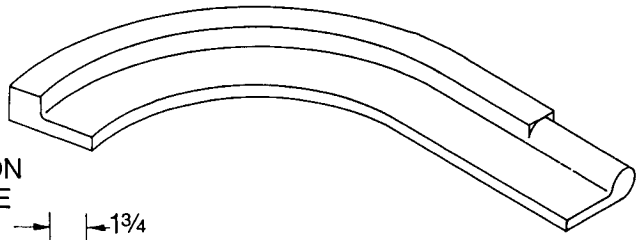


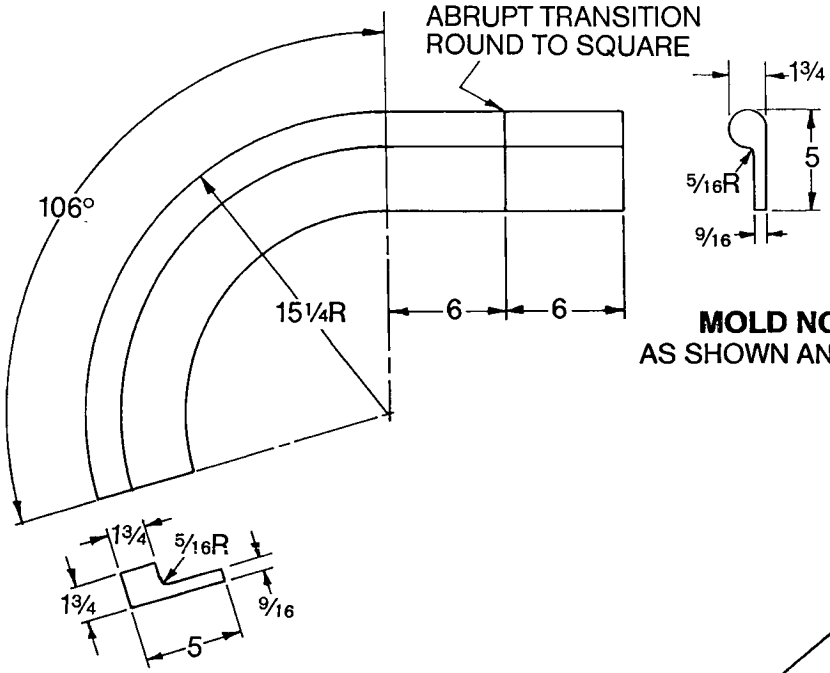


MOLD NO. 4308
AS SHOWN AND OPPOSITE

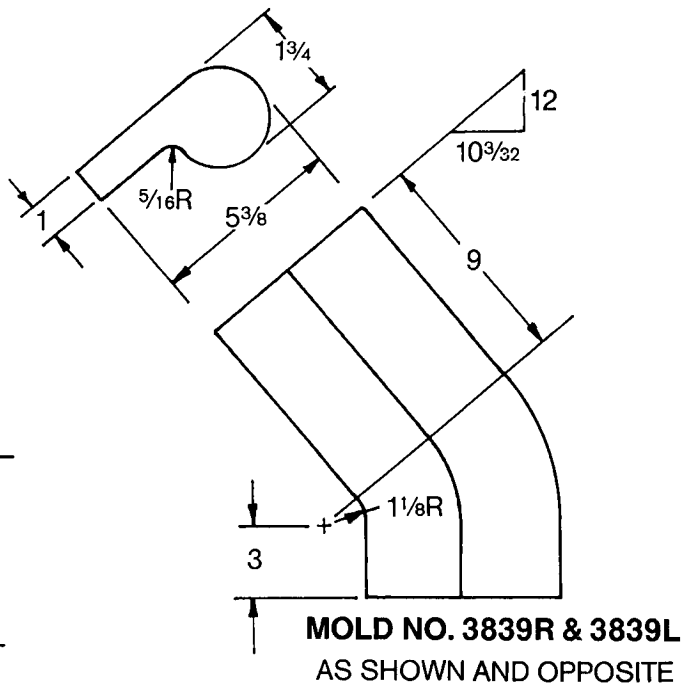


F-8

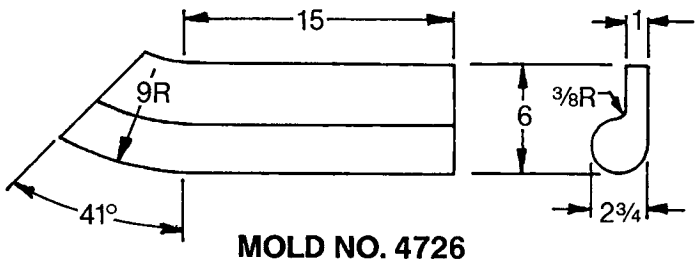




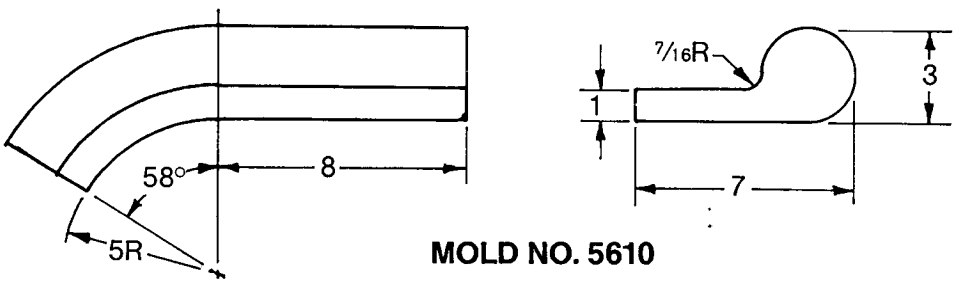
MOLD NO. 6560
AS SHOWN AND OPPOSITE



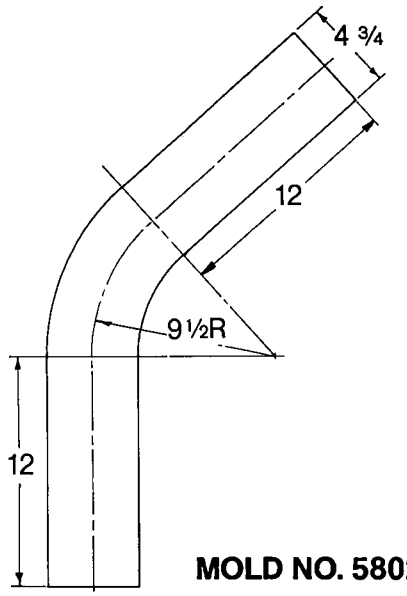
MOLD NO. 3839R & 3839L
AS SHOWN AND OPPOSITE



MOLD NO. 4726
AS SHOWN AND OPPOSITE



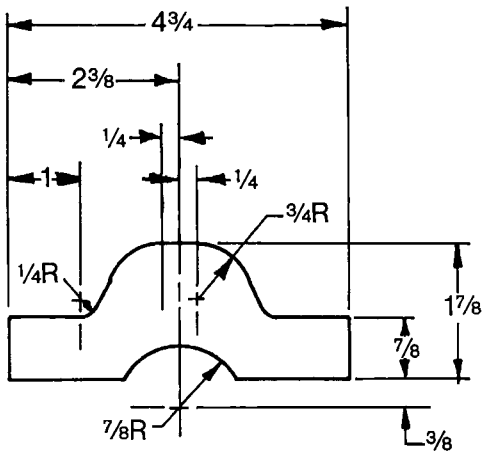
MOLD NO. 5610
AS SHOWN AND OPPOSITE

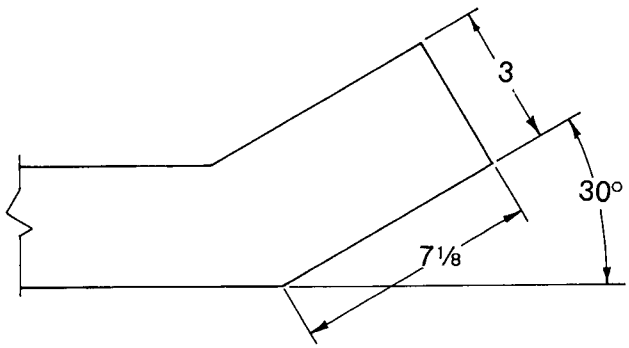


MOLD NO. 5802

TRIM EITHER END AS REQUIRED
FOR RIGHT OR LEFT HAND

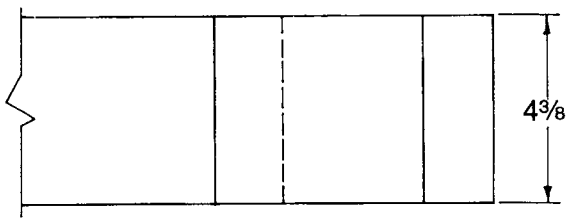
TYPICAL CROSS SECTION
PER MOLD NO. 3621-A

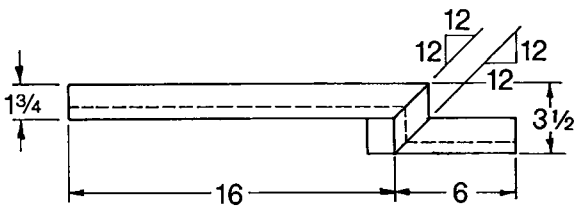




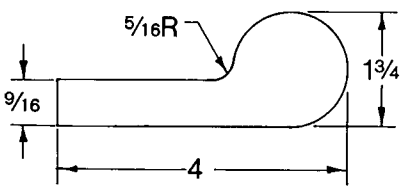
MOLD NO. 4279

MOLD FOR SPLICING ANGLED END
PIECE TO 3" THICK x 4 3/8" SEAL

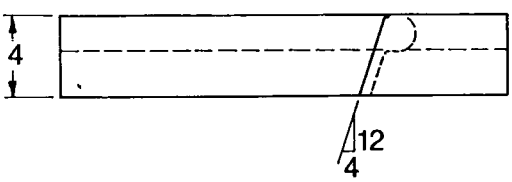




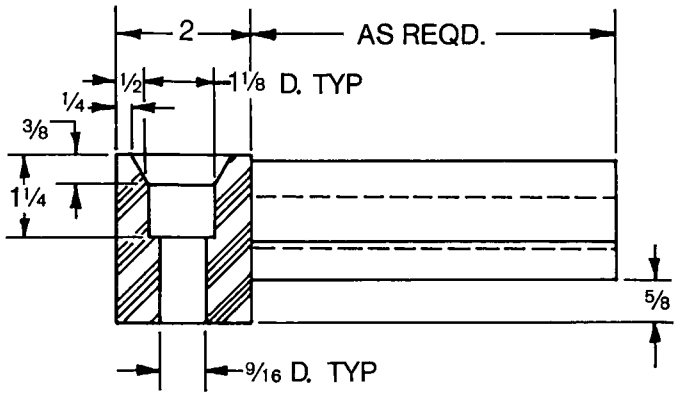
MOLD NO. 5590 & 5591
AS SHOWN AND OPPOSITE



TYPICAL CROSS SECTION

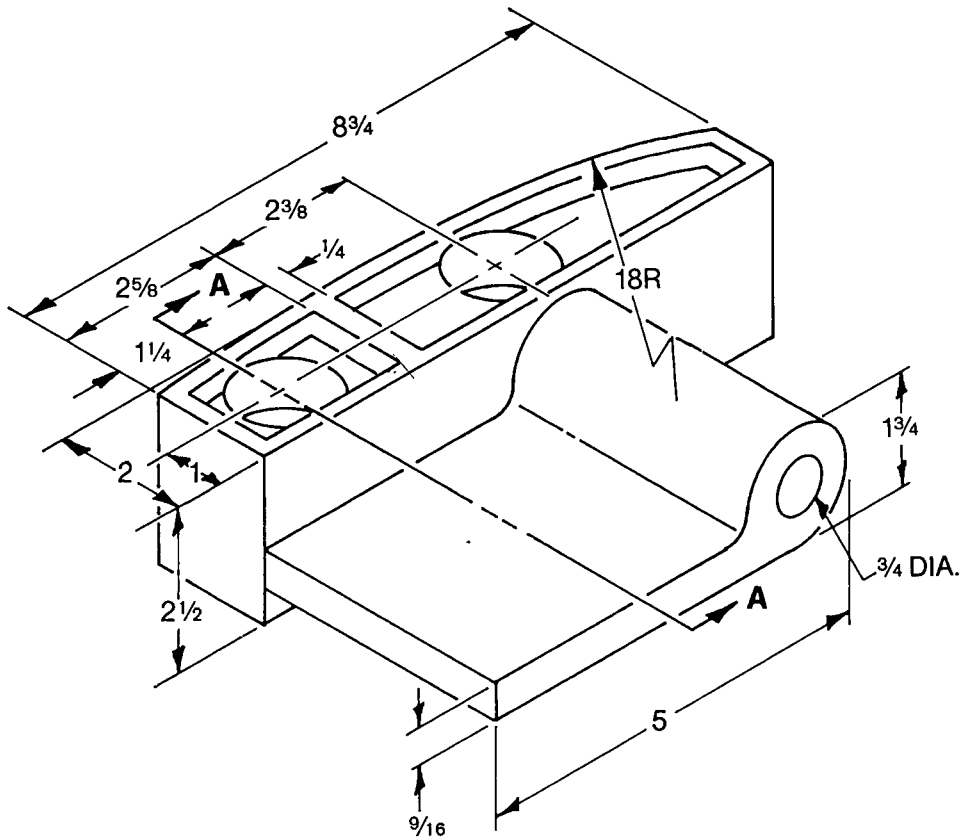


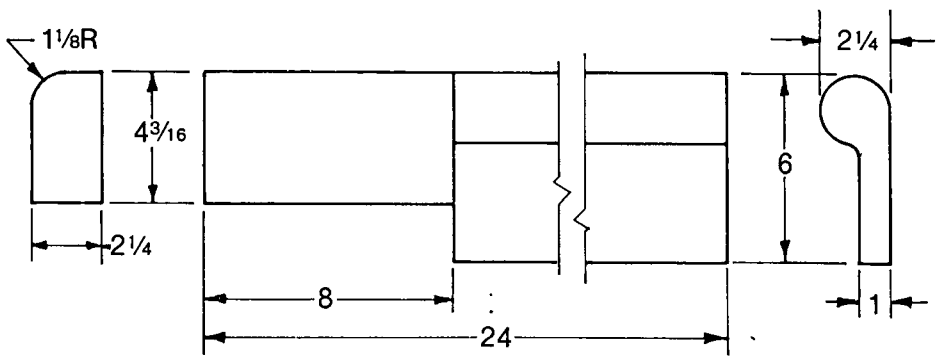
F-10



SECTION A-A

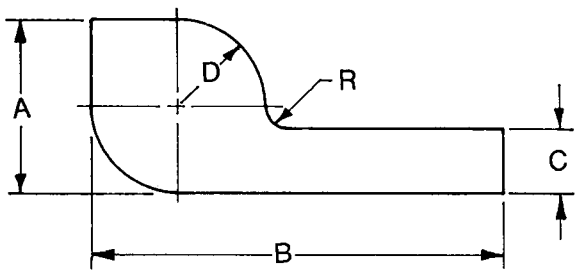
MOLD NO. 3992 & 3993
AS SHOWN AND OPPOSITE



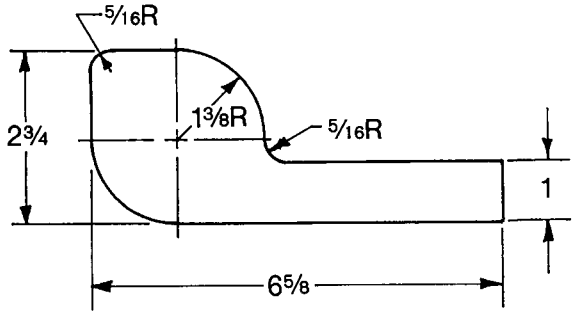


MOLD NO. 5603
AS SHOWN AND OPPOSITE

G-1

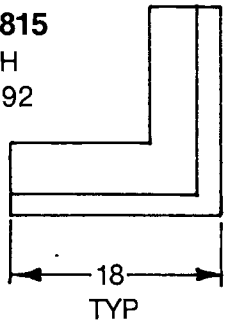


MOLD NO.	A	B	C	D	R
3492	2¾	6⅝	1	1⅜	5/16
6258	2¾	7⅝	1	1⅜	⅜
4802	2⅜	7 5/16	1	1 3/16	3/16

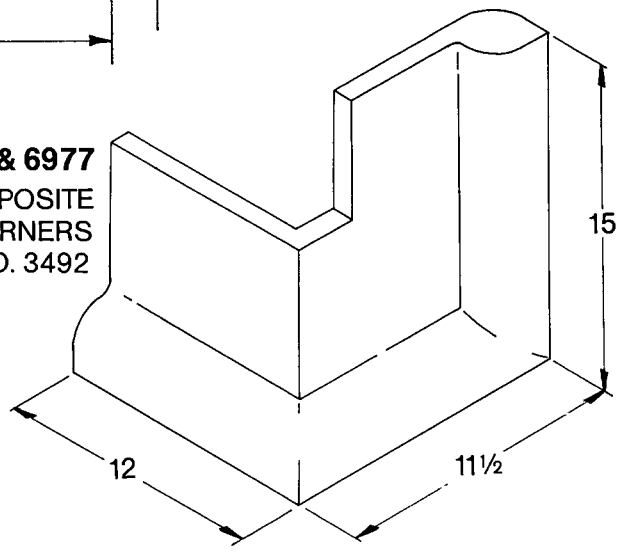


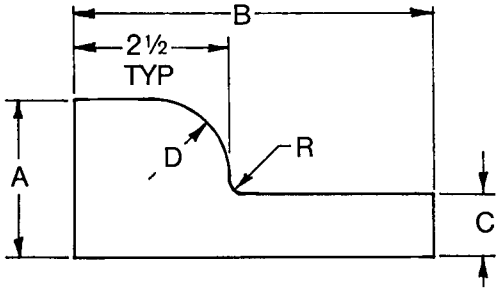
MOLD NO. 3492-A

FLAT OUTSIDE BULB
MOLD NO. 4815
FOR USE WITH
MOLD NO. 3492
OR 3492-A
(ABOVE)

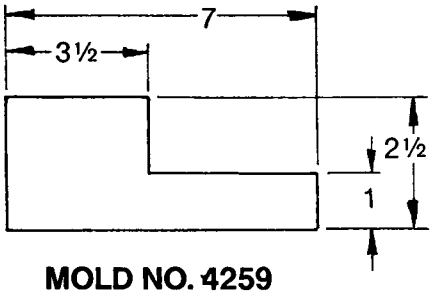


MOLD NO. 6976 & 6977
AS SHOWN AND OPPOSITE
TRANSITION CORNERS
FOR SEAL NO. 3492



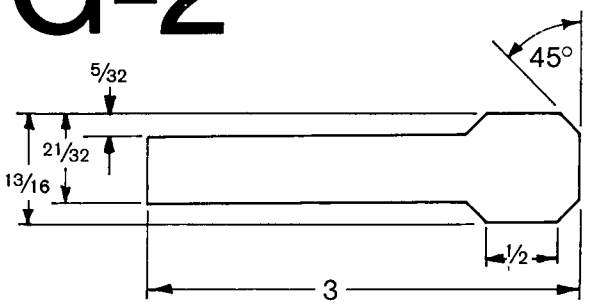


MOLD NO.	A	B	C	D	R
4446	2½	5¾	1	1¼	3/16
4804	2½	7¼	1	1¼	—
4735	2½	6⅝	1	1¼	¼

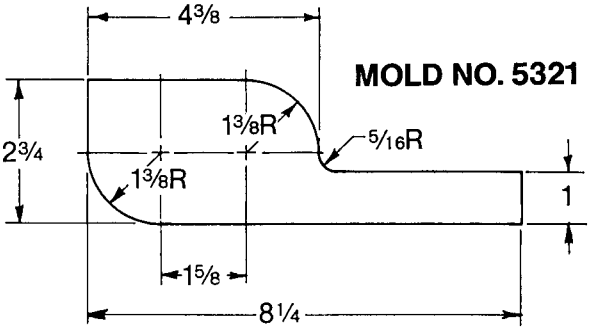


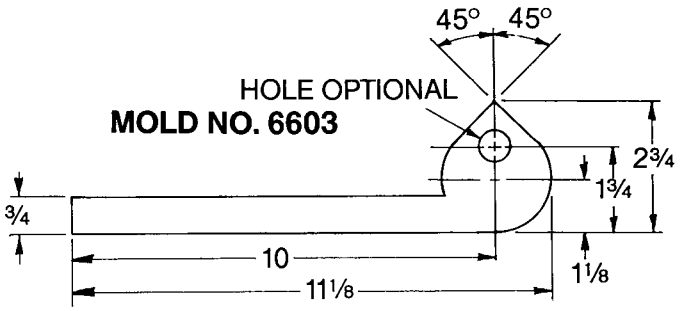
MOLD NO. 4259

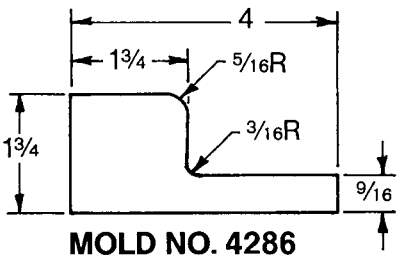
G-2



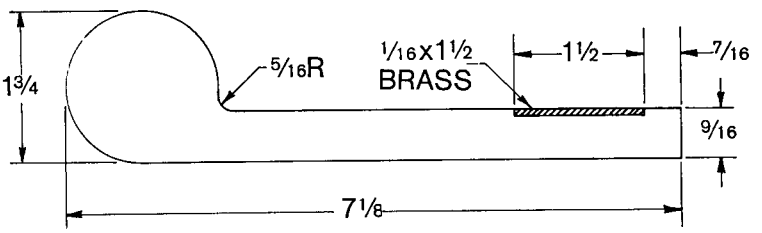
MOLD NO. 6114



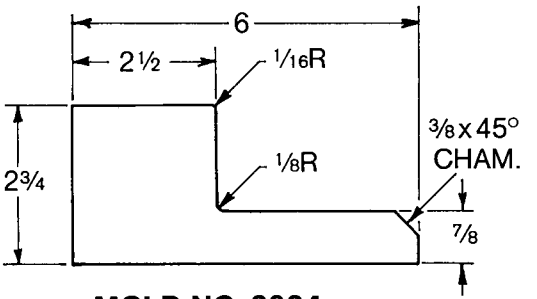




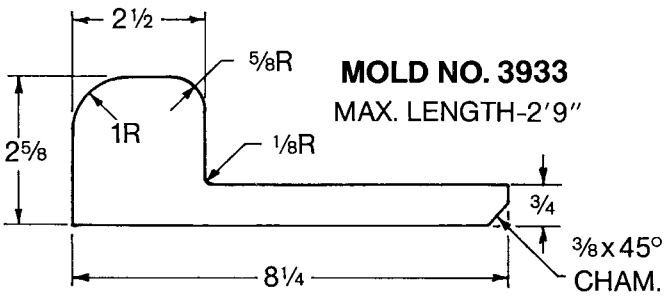
MOLD NO. 4286
MAX. LENGTH 3'5"

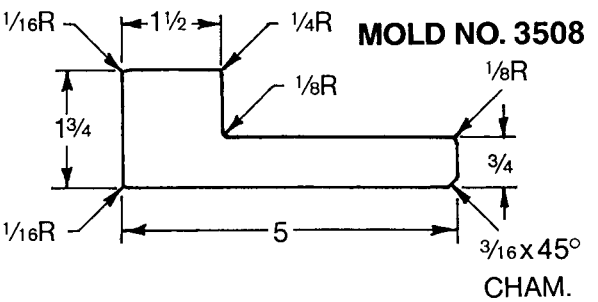


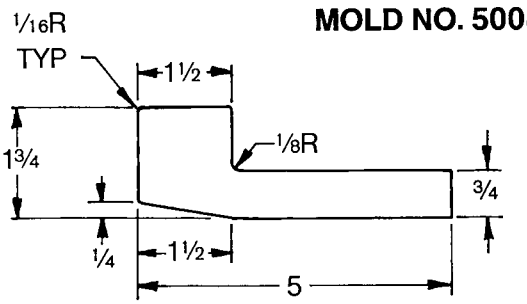
MOLD NO. 4287
MAX. LENGTH 3'5"

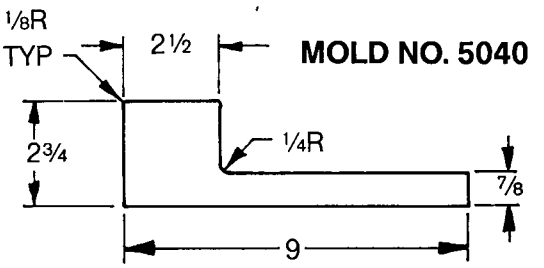


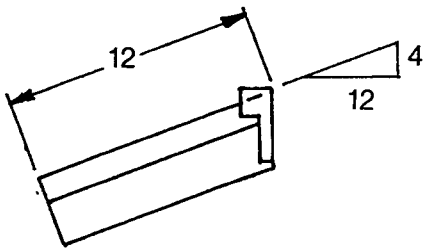
MOLD NO. 3934
MAX. LENGTH 3'5"

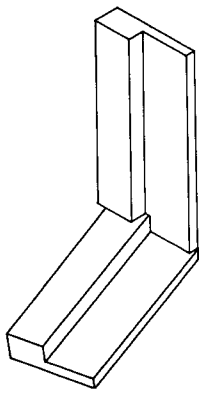


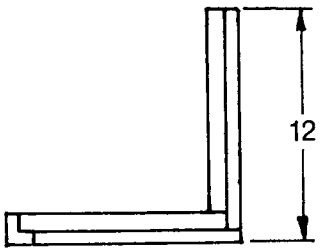






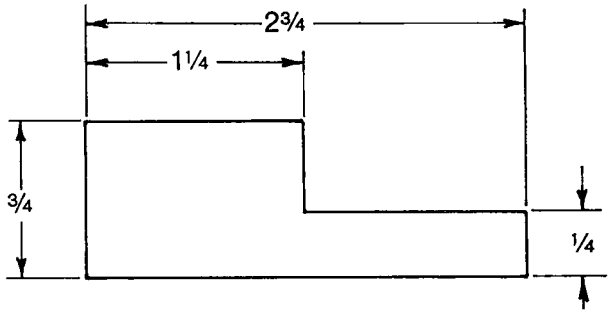




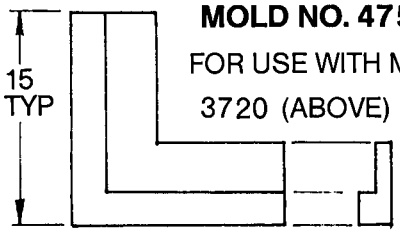


MOLD NO. 4680 & 4681

AS SHOWN AND OPPOSITE TYPICAL CROSS SECTION MOLD NO. 3720

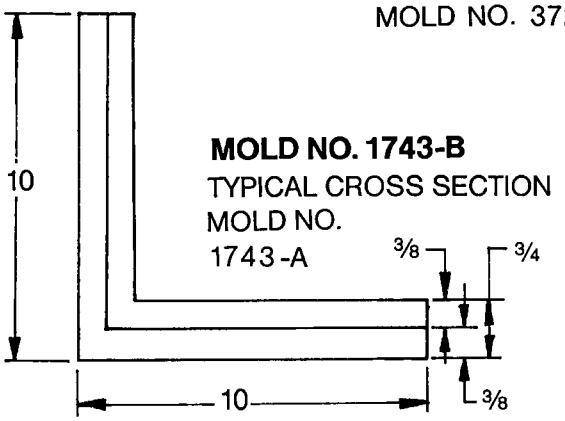


STRIP MOLD NO. 3720



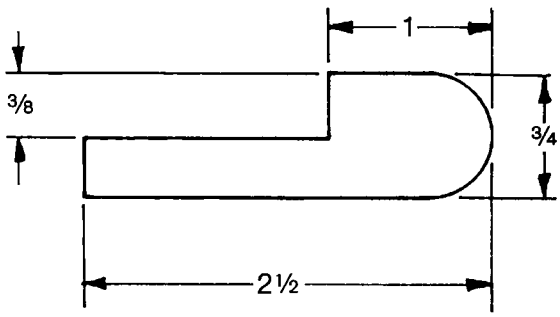
MOLD NO. 4759

FOR USE WITH MOLD 3720 (ABOVE)

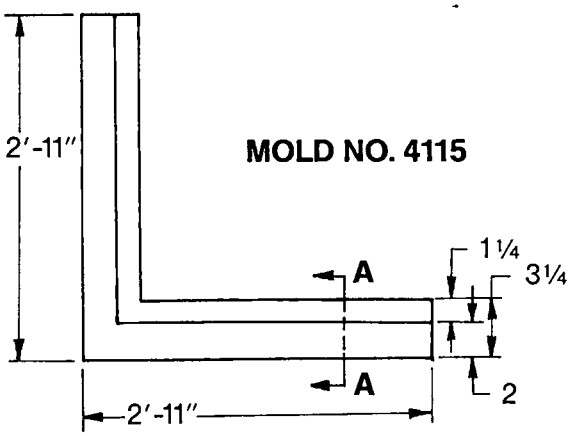


MOLD NO. 1743-B

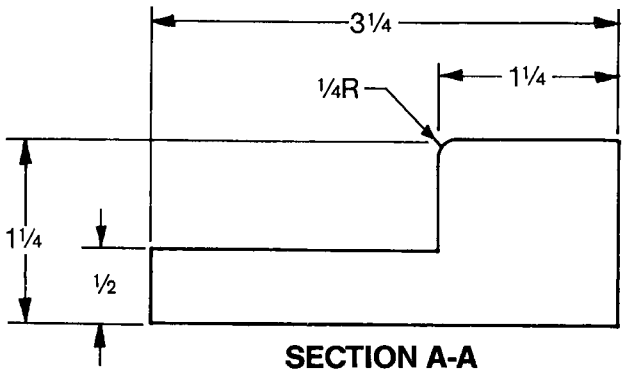
TYPICAL CROSS SECTION MOLD NO. 1743-A



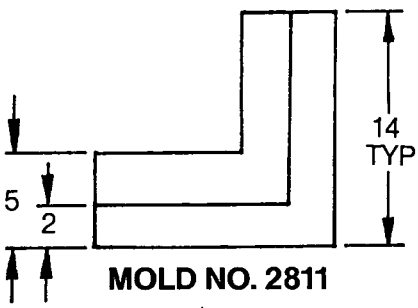
STRIP MOLD NO. 1743-A



MOLD NO. 4115

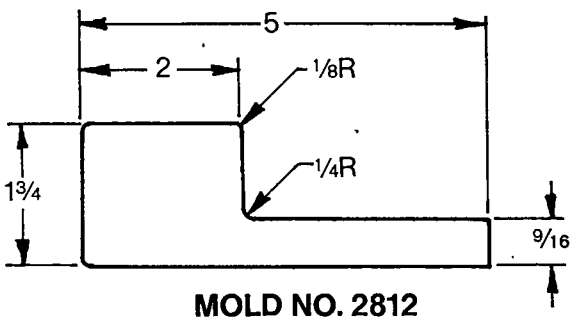


SECTION A-A



MOLD NO. 2811

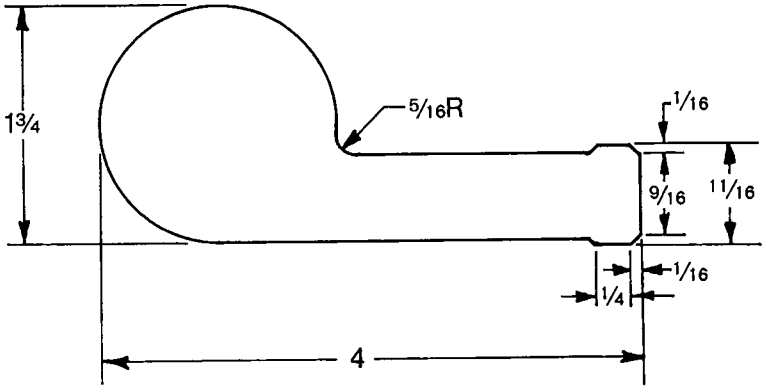
USE WITH NO. 2812



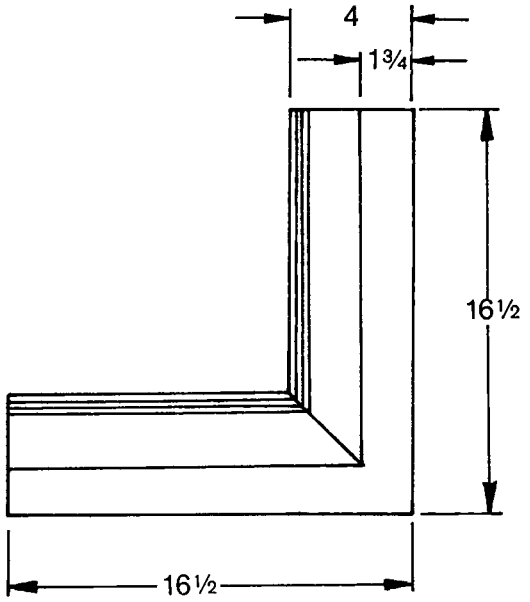
MOLD NO. 2812

MOLD WILL PRODUCE ANY LENGTH STRAIGHT SECTION

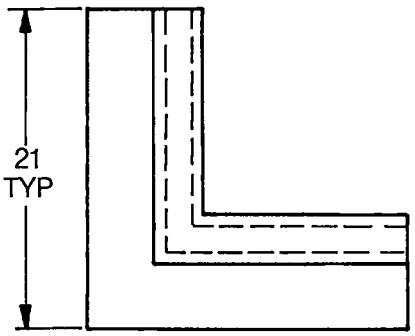
G-4



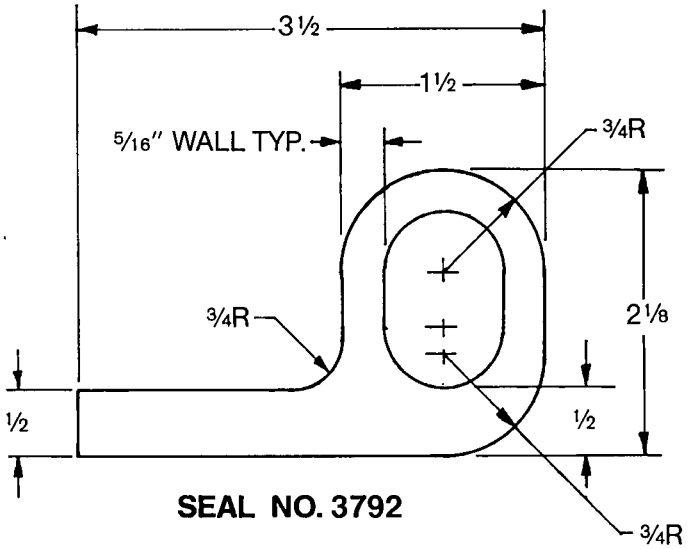
STRIP MOLD NO. 2329



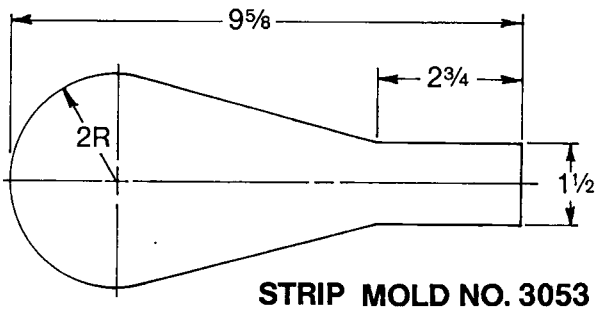
MOLD NO. 2330
TYPICAL CROSS SECTION
MOLD NO. 2329



CORNER MOLD NO. 3794
TYPICAL CROSS SECTION
MOLD NO. 3792

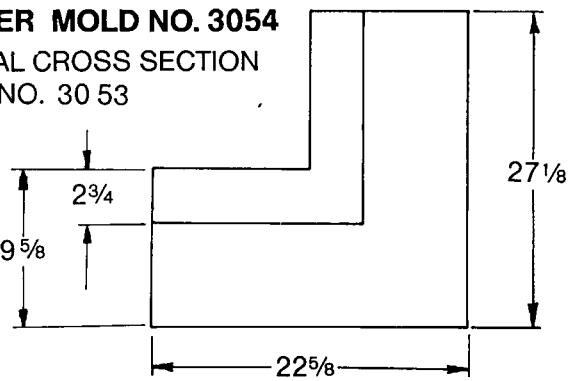


SEAL NO. 3792

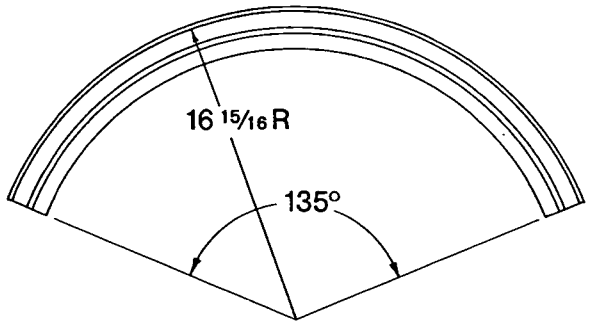


STRIP MOLD NO. 3053

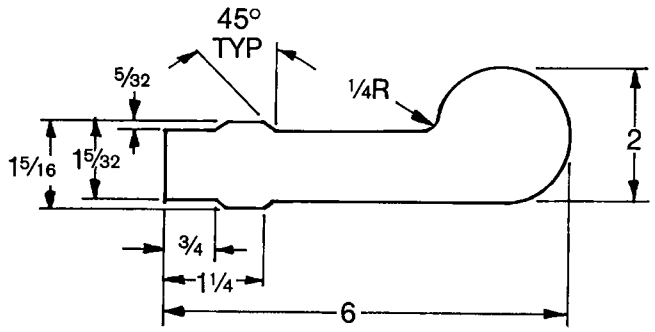
CORNER MOLD NO. 3054
TYPICAL CROSS SECTION
MOLD NO. 3053

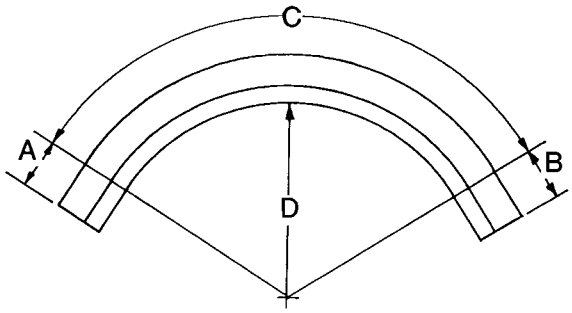


MOLD NO. 6113

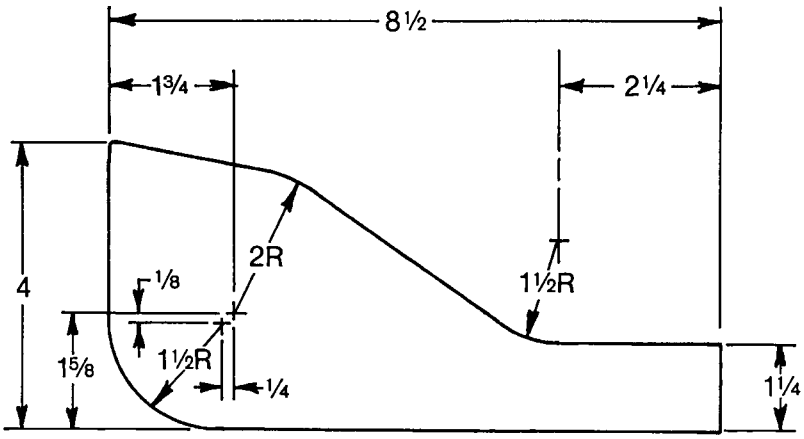


TYPICAL CROSS SECTION
MOLD NO. 6113



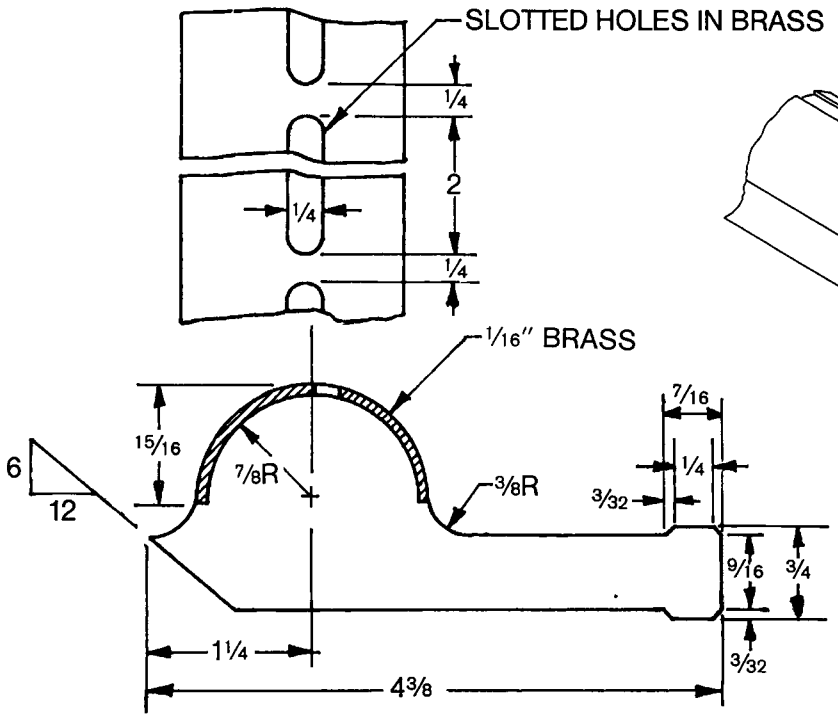


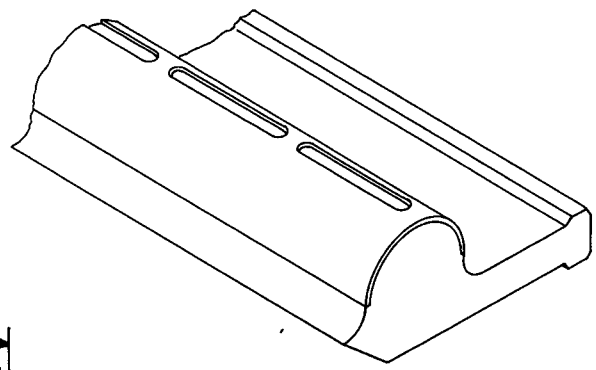
TYPICAL CROSS SECTION
MOLD NO. 2990



MOLD NO. 2990

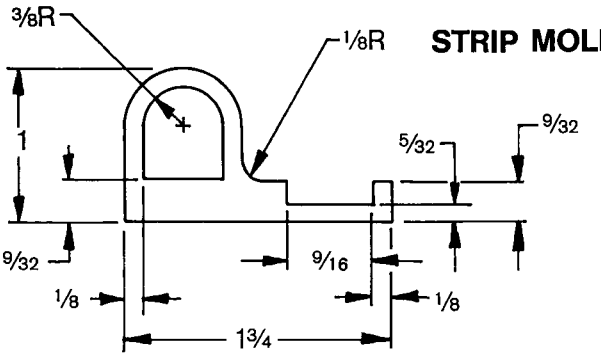
MOLD NO.	A	B	C	D
4779	8	8	115°	32 1/4R
4753	8	8	60°	27 3/4R





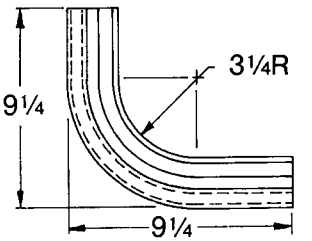
BRASS CLAD GATE SEAL
MOLD NO. 2441-A
10'-0" MAX. LENGTH

G-6

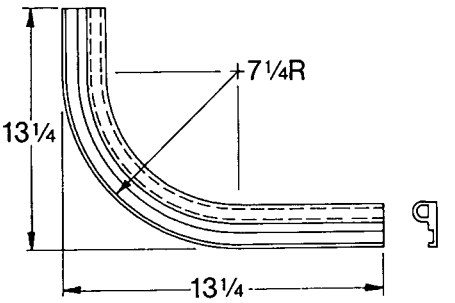


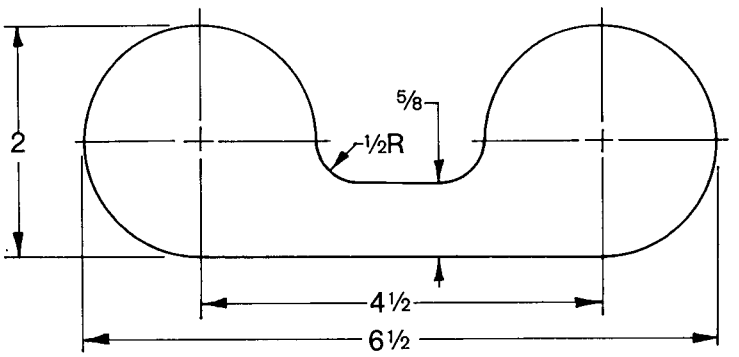
STRIP MOLD NO. 6493

MOLD NO. 6495

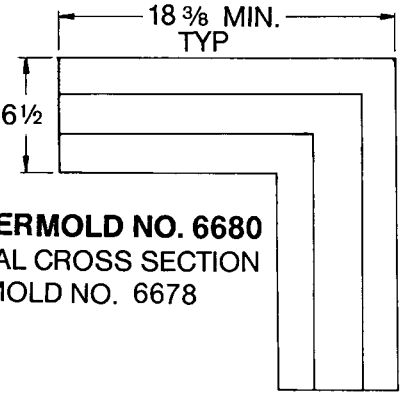


MOLD NO. 6494

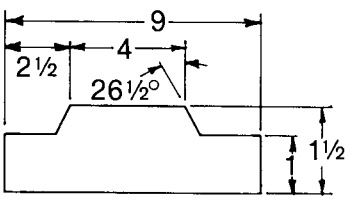




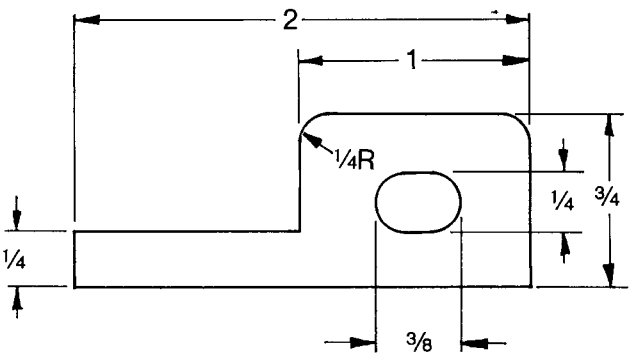
DOUBLE BULB SEAL
STRIP MOLD NO. 6678
SPLICE MOLD NO. 6679



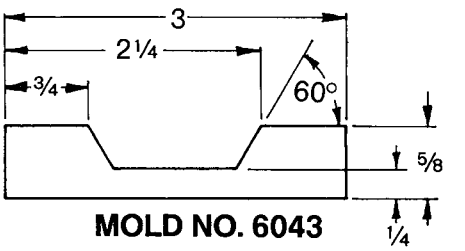
CORNER MOLD NO. 6680
TYPICAL CROSS SECTION
PER MOLD NO. 6678



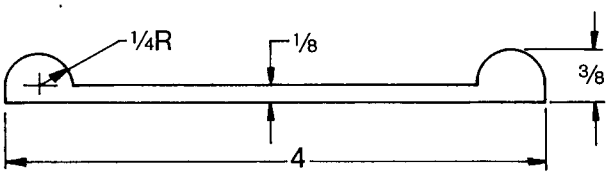
PART NO. 74A2374



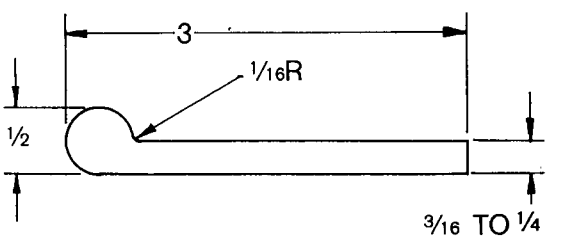
MOLD NO. B1-1214-72
60 TO 70 DURO SBR



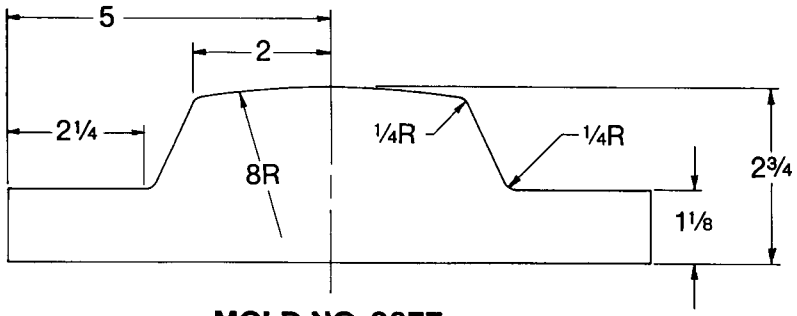
MOLD NO. 6043



MOLD NO. B 1-91-72
40 TO 50 DURO NEOPRENE



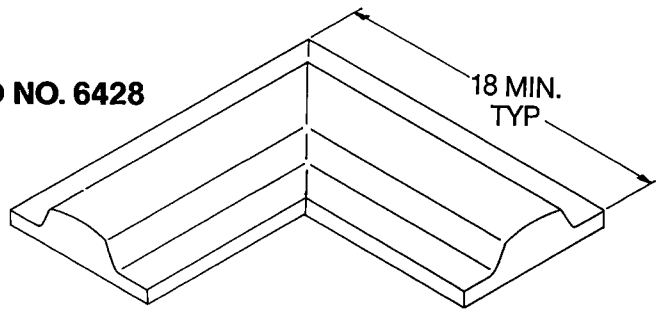
MOLD NO. B-1-521-71
60 TO 70 DURO NATURAL RUBBER

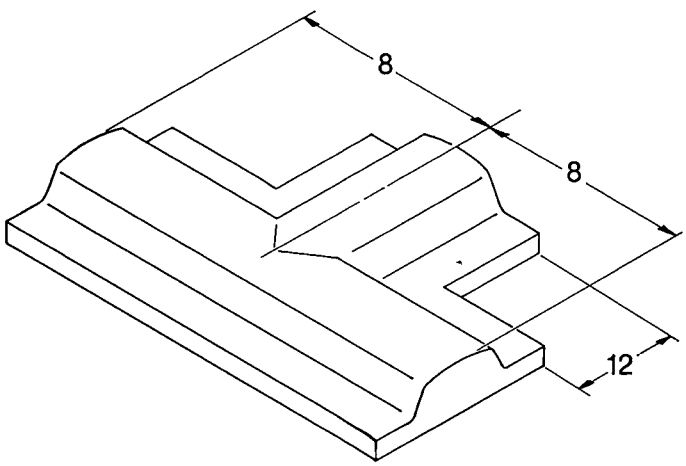


MOLD NO. 3677

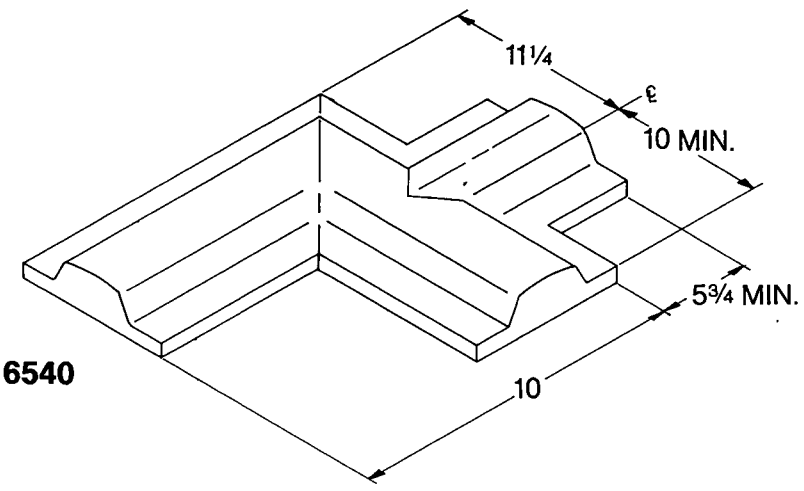
TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE

MOLD NO. 6428



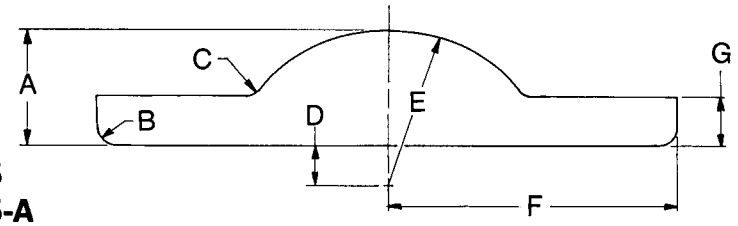


MOLD NO. 6435



MOLD NO. 6540

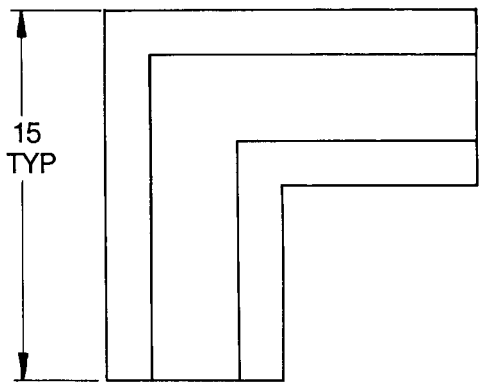
H-2



MOLD NO. 1905
MOLD NO. 1905-A

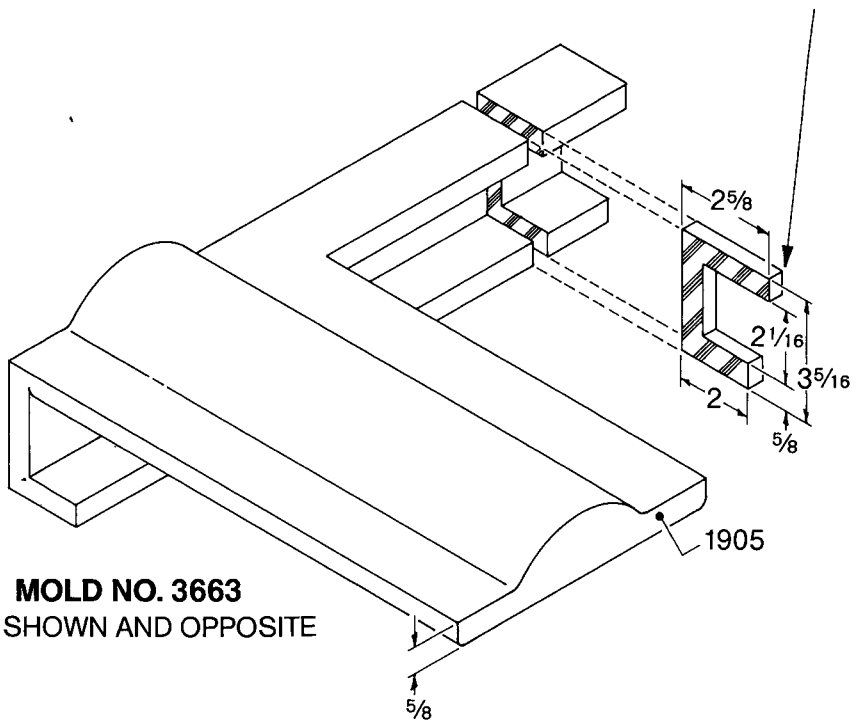
MOLD NO.	A	B	C	D	E	F	G
1905	1½	¼R	¼R	¾	2¼	3¾	⅝
1905-A	1⅜	¼R	¼R	⅞	2¼	3¾	½

TYPICAL CROSS SECTION
FOR ALL MOLDS BELOW
SEE MOLD NO. 1905 (ABOVE)

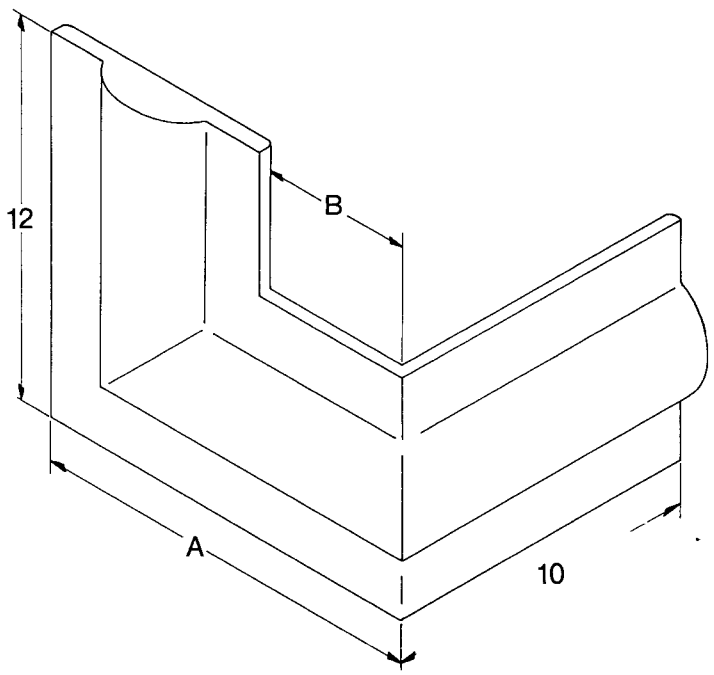


MOLD NO. 1906

TYPICAL CROSS SECTION
MOLD NO. 3547 PAGE J-6

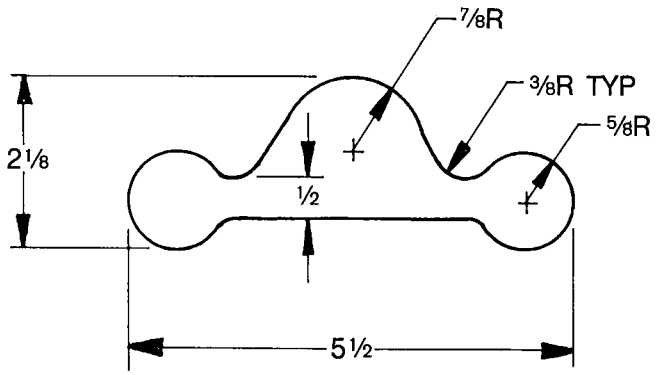


MOLD NO. 3663
AS SHOWN AND OPPOSITE

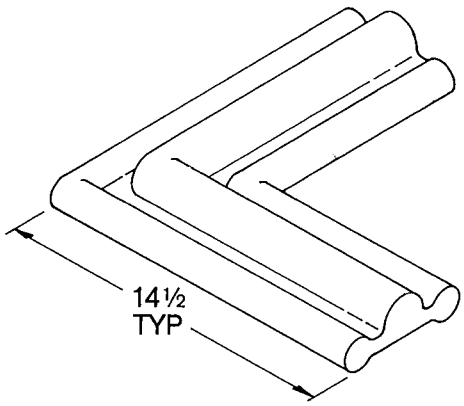


MOLD NO. 5004 & 5005
MOLD NO. 5002 & 5003
AS SHOWN AND OPPOSITE

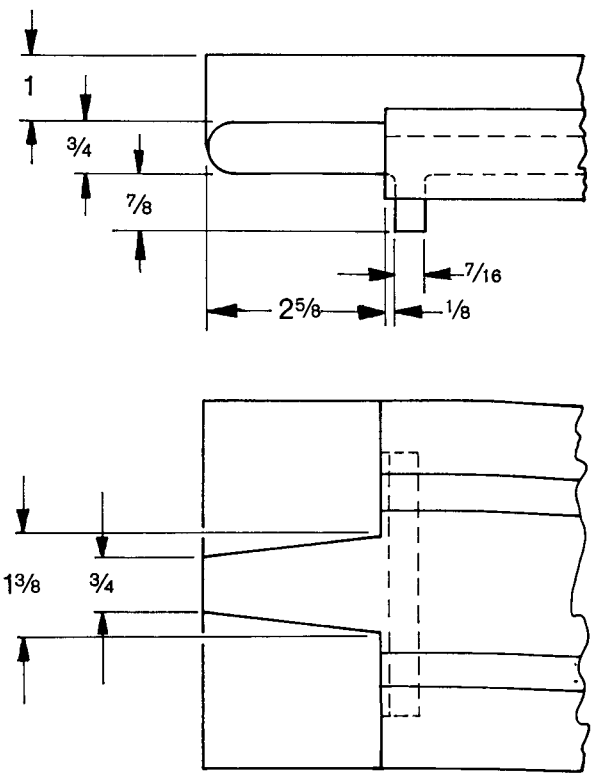
MOLD NO.	A	B
5002 & 5003	9 13/16	13/16
5004 & 5005	13 9/16	4 9/16

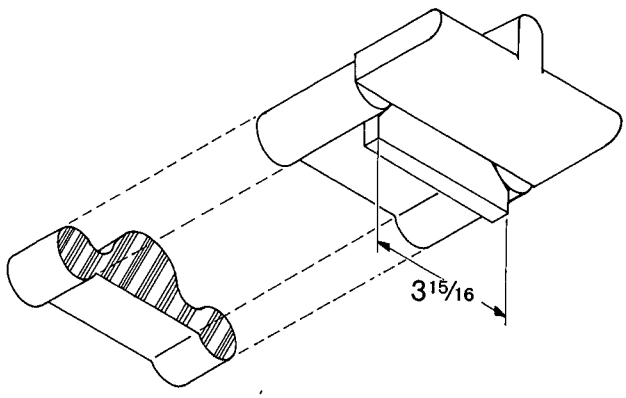


STRIP MOLD NO. 2933

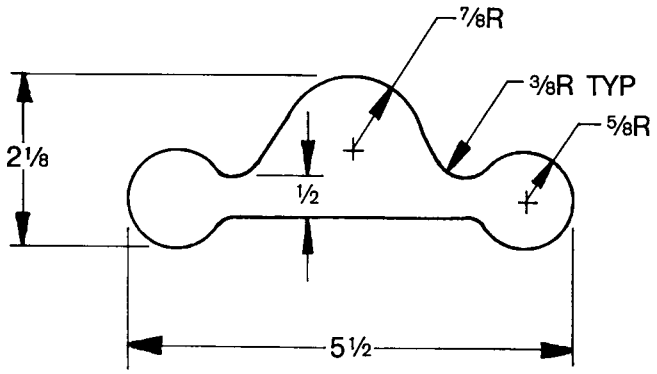


MOLD NO. 2918
TYPICAL CROSS SECTION
SEE MOLD NO. 2933 (ABOVE)

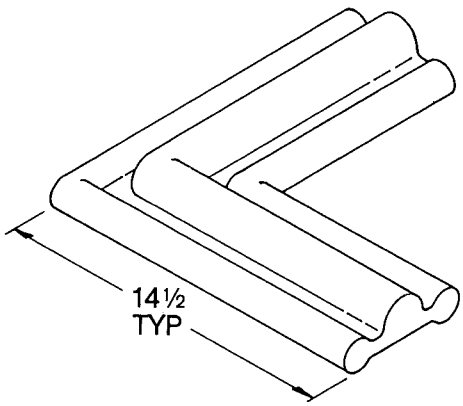




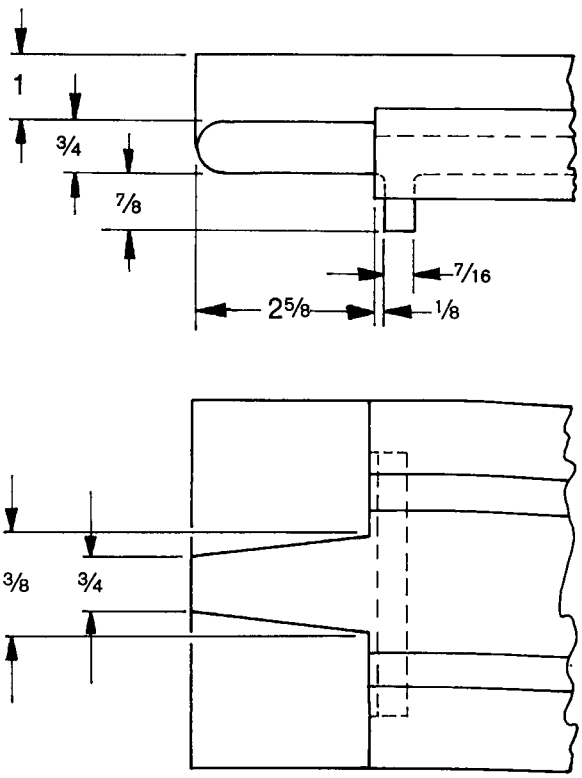
SPECIAL END SECTION FOR MOLD NO. 2933
(SHOWN ABOVE)

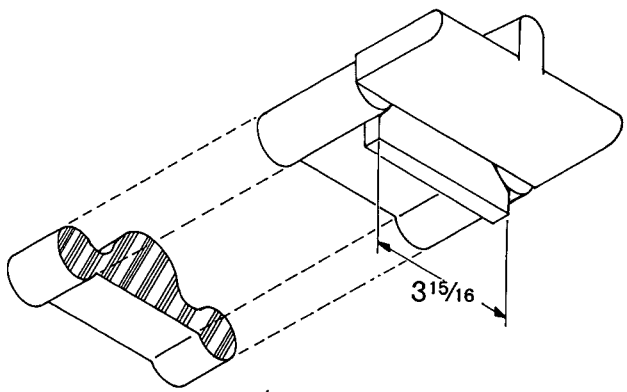


STRIP MOLD NO. 2933

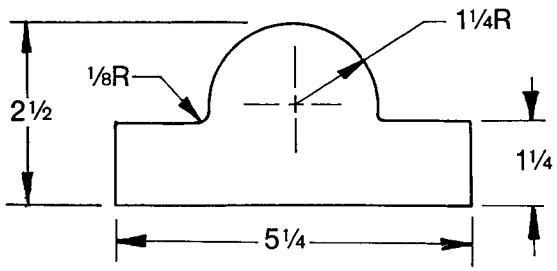


MOLD NO. 2918
TYPICAL CROSS SECTION
SEE MOLD NO. 2933 (ABOVE)



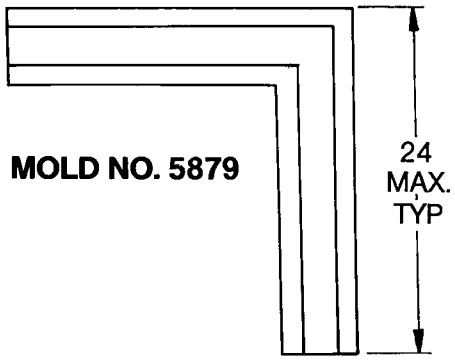


SPECIAL END SECTION FOR MOLD NO. 2933
(SHOWN ABOVE)

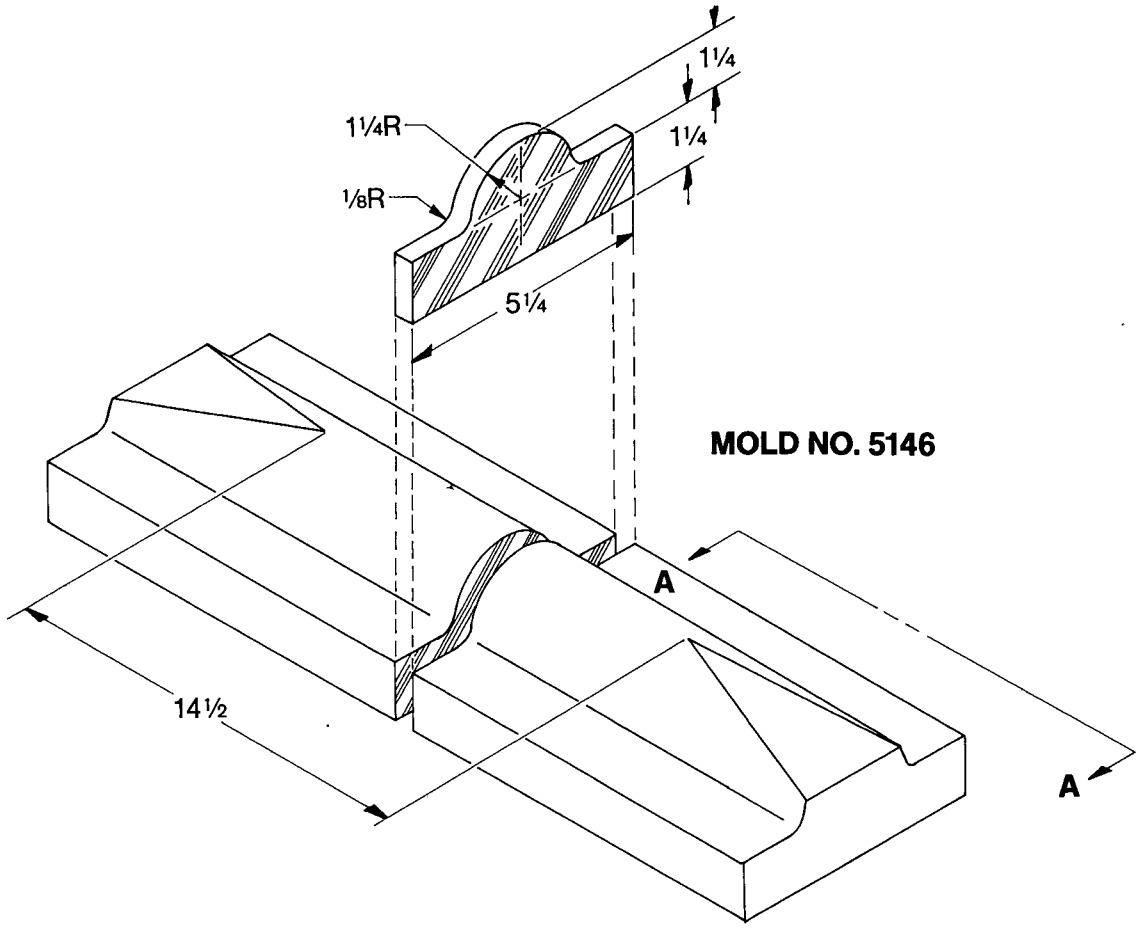


MOLD NO. 4258

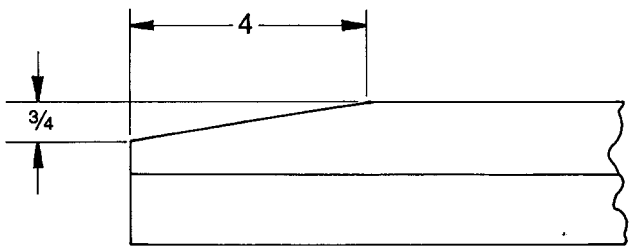
TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE



MOLD NO. 5879

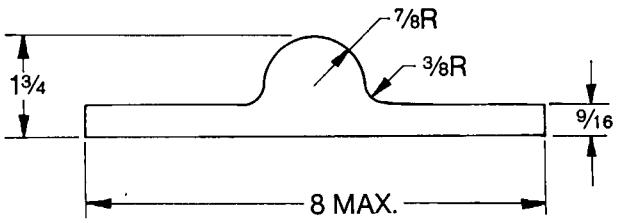


MOLD NO. 5146



SECTION A-A
TYPICAL END

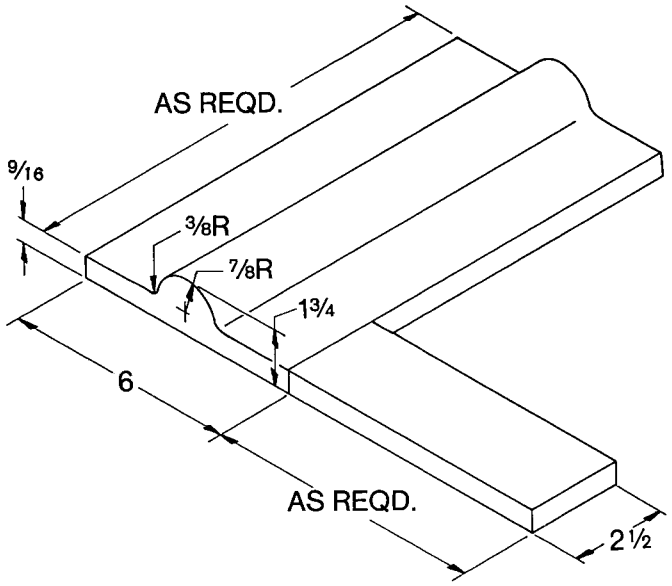
H-6

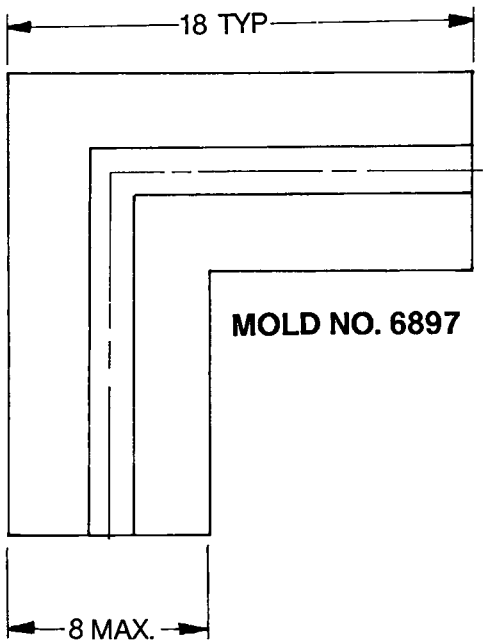


MOLD NO. 4767

TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE
— WIDTHS AS SHOWN

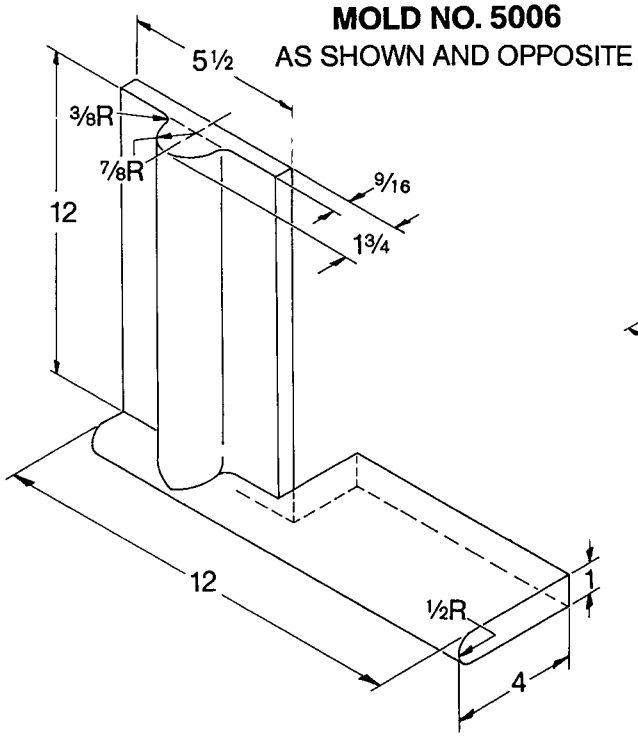
MOLD NO. 6275
AS SHOWN AND OPPOSITE

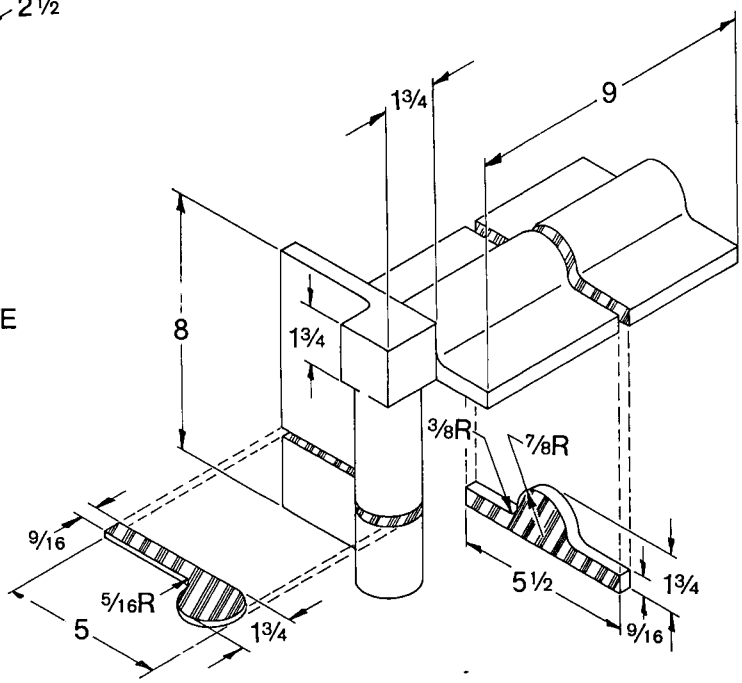




MOLD NO. 6897

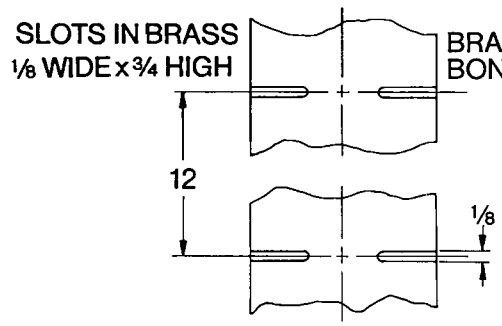
MOLD NO. 5006
AS SHOWN AND OPPOSITE

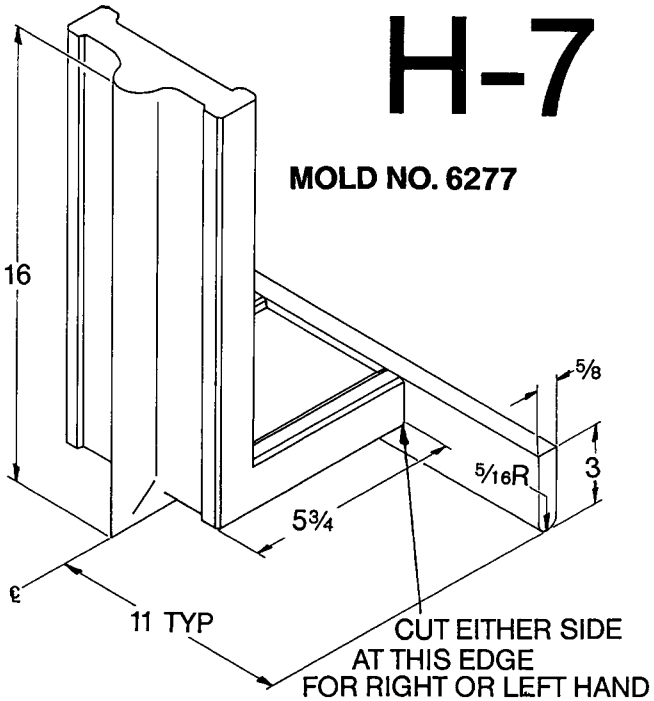




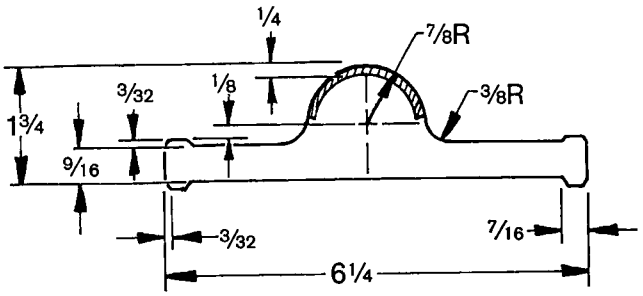
MOLD NO. 4788 & 4789
AS SHOWN AND OPPOSITE

SIDE VIEW, MOLD NO. 5006



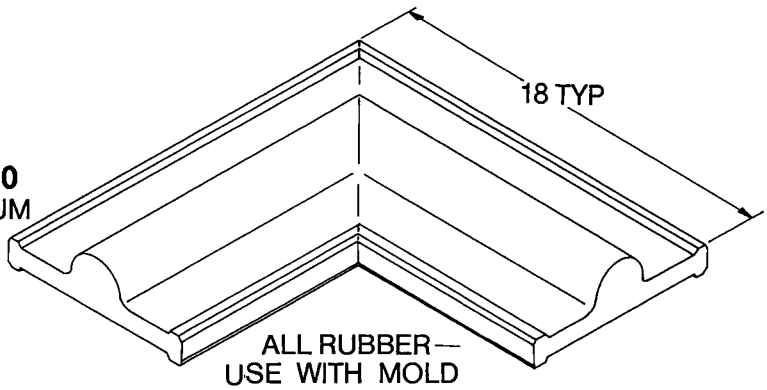


MOLD NO. 6277



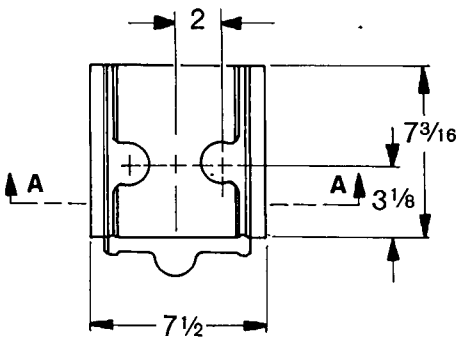
STRIP MOLD NO. 2441

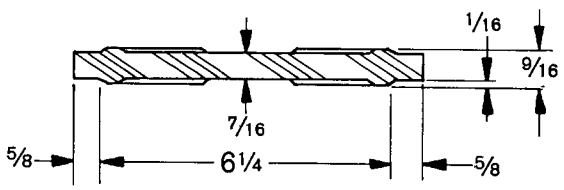
TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE



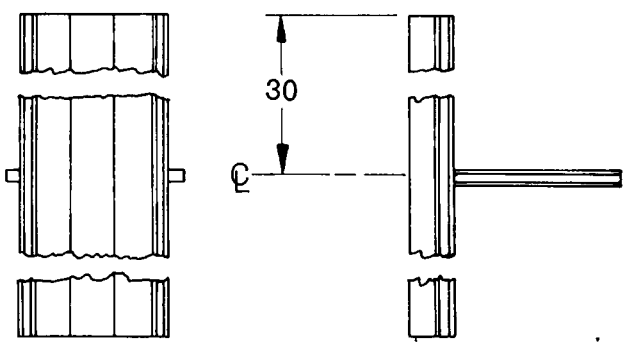
CORNER MOLD NO. 2440
IF BRASS-CLAD, MAXIMUM
LEG LENGTH IS 14"

ALL RUBBER—
USE WITH MOLD
2284 PAGE H-8



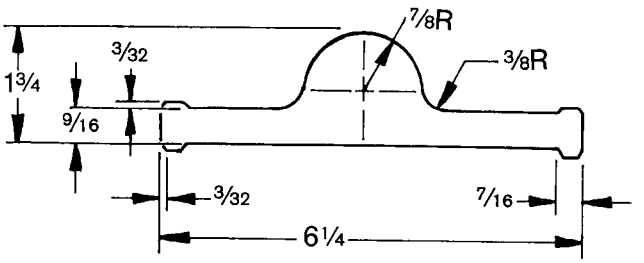


SECTION A-A



MOLD NO. 6278

H-8



MOLD NO. 2284

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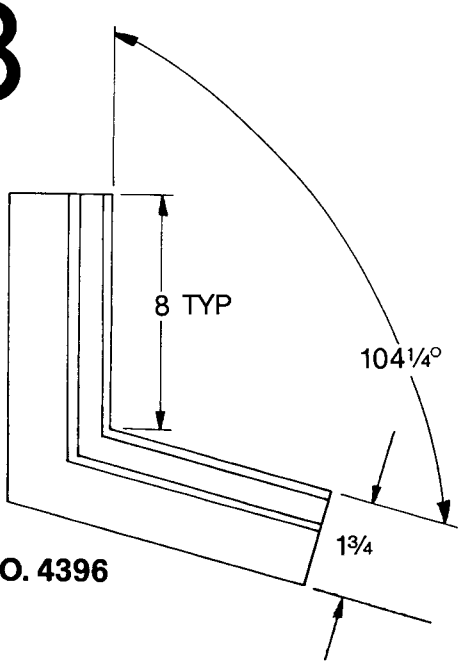
FOR ALL MOLDS ON THIS PAGE



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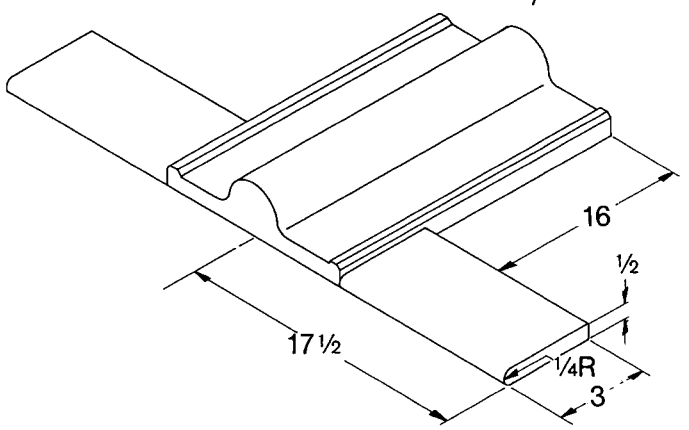

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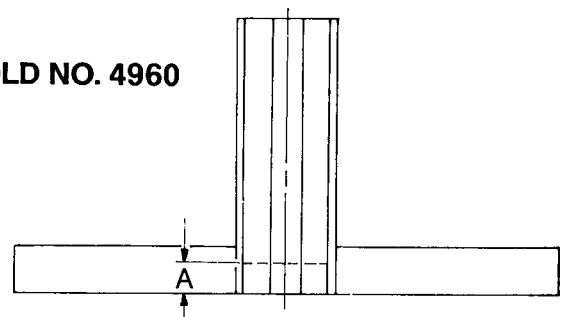
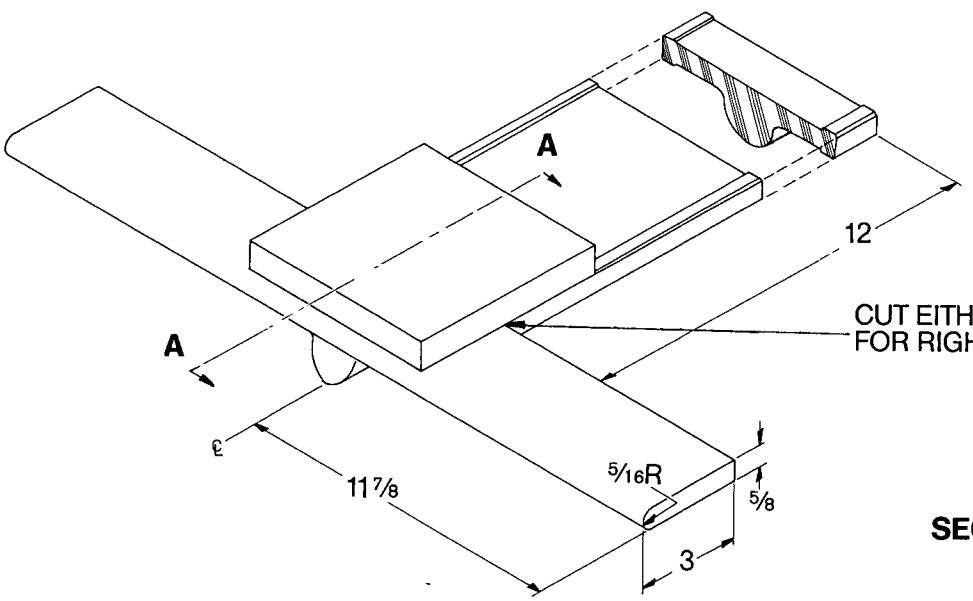


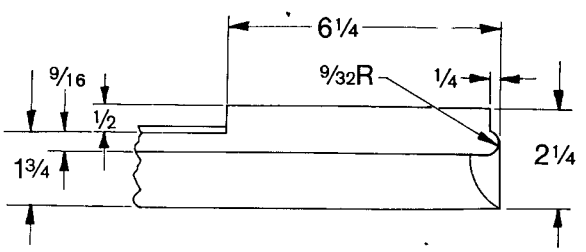
"A" DIM.—2 & 2 1/8-
MOLD TO PROVIDE BOTH



MOLD NO. 3589

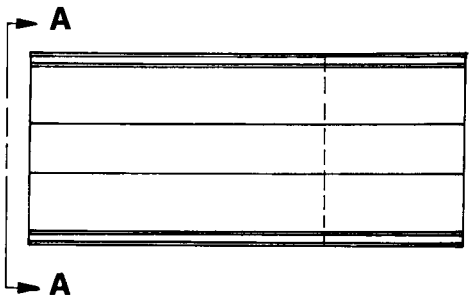
CUT EITHER SIDE AT THIS EDGE
FOR RIGHT OR LEFT HAND

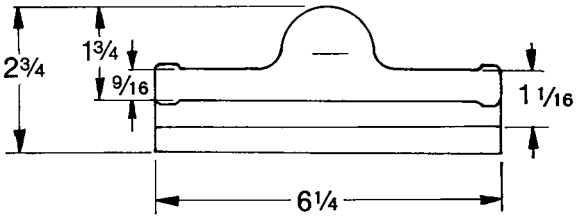
SECTION A-A



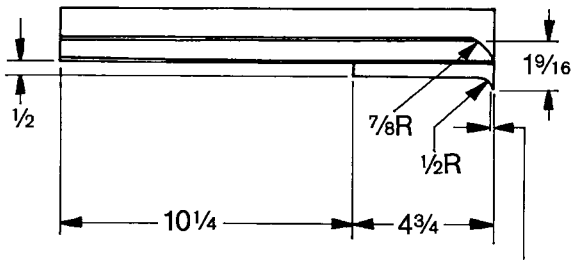
TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE
SEE MOLD NO. 2284, PAGE H-8

MOLD NO. 5911

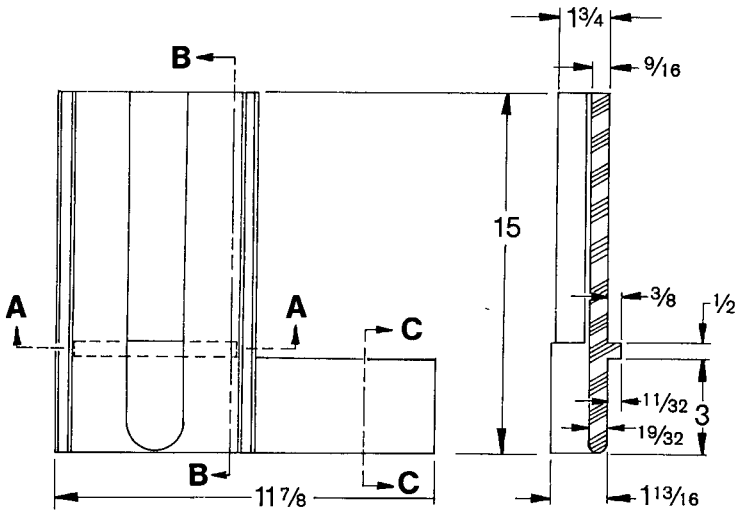




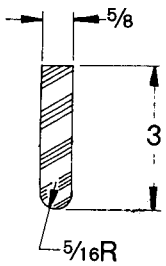
SECTION A-A



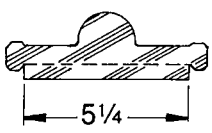
1/16 TO FEATHERED EDGE



SECTION B-B



SECTION C-C

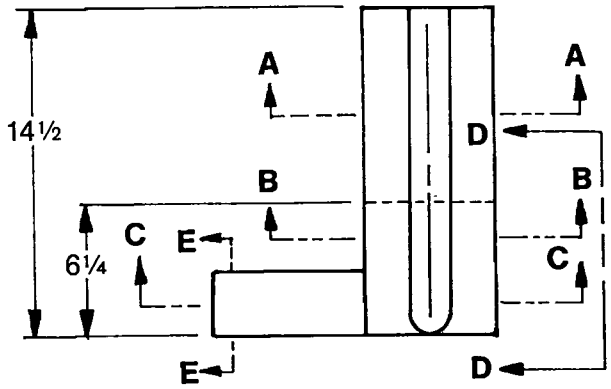


SECTION A-A

MOLD NO. 3589-MODIFIED

AS SHOWN AND OPPOSITE

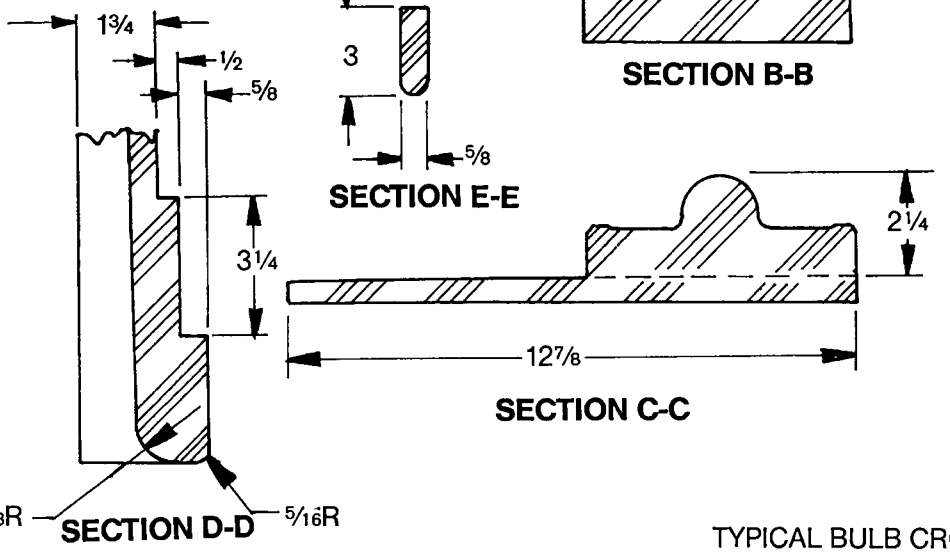
H-10



SECTION A-A

MOLD NO. 3331
AS SHOWN AND OPPOSITE

SECTION B-B

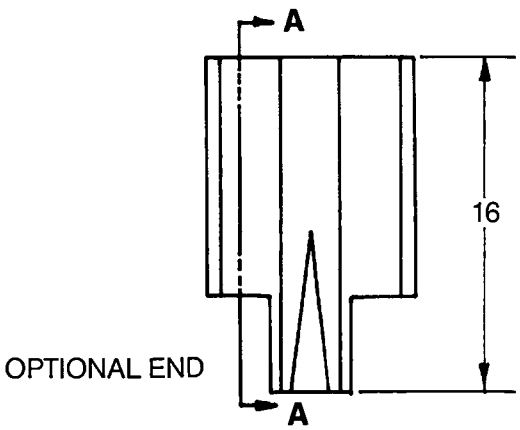


SECTION E-E

SECTION C-C

SECTION D-D

TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE
SEE MOLD NO. 2284, PAGE H-8



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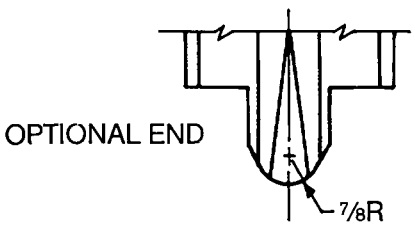
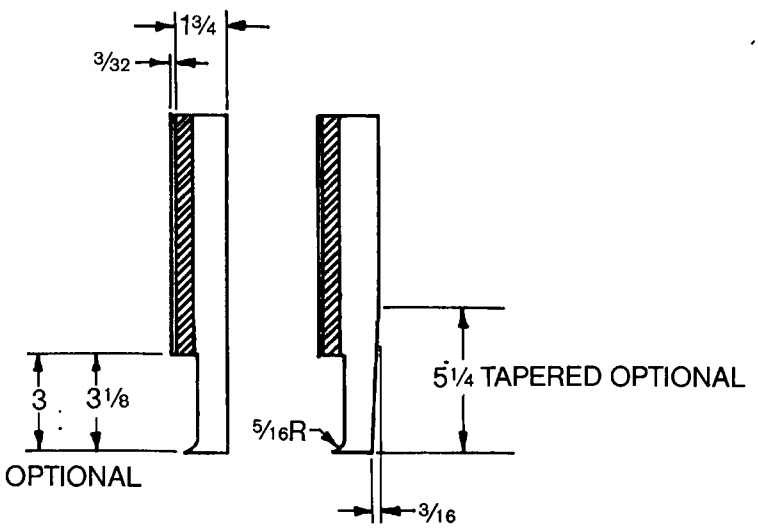
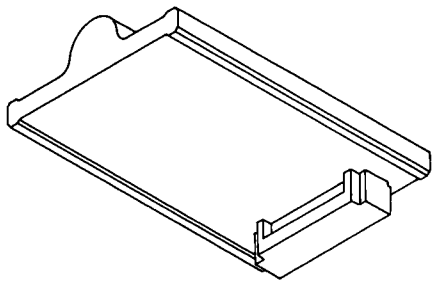
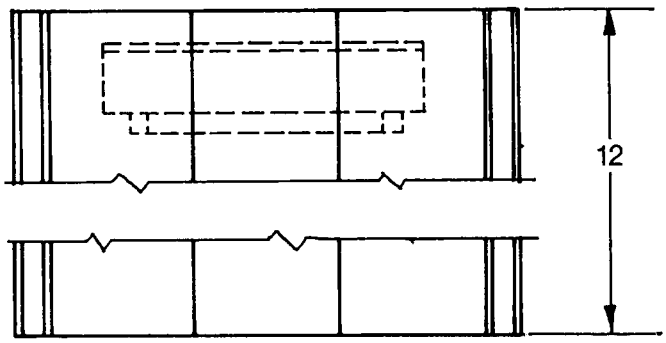




SECTION A-A

TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE
SEE MOLD NO. 2284 PAGE H-8





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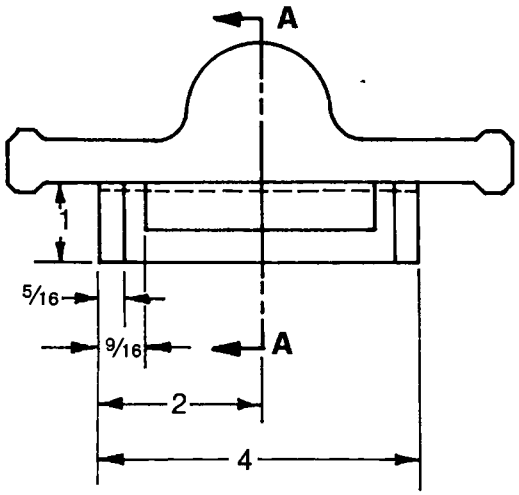
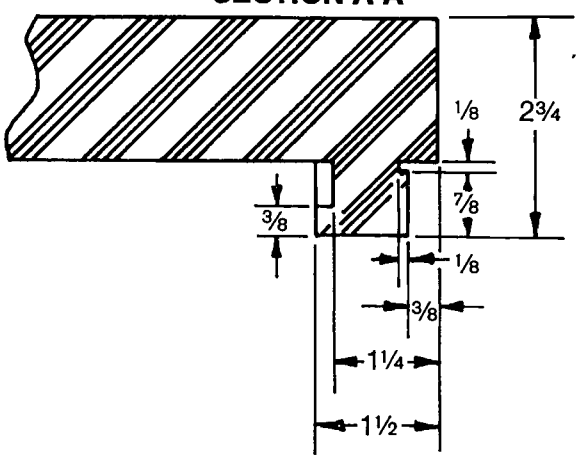
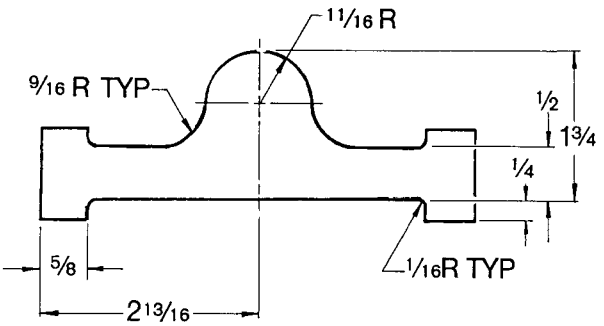


SECTION A-A



H-12



TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE

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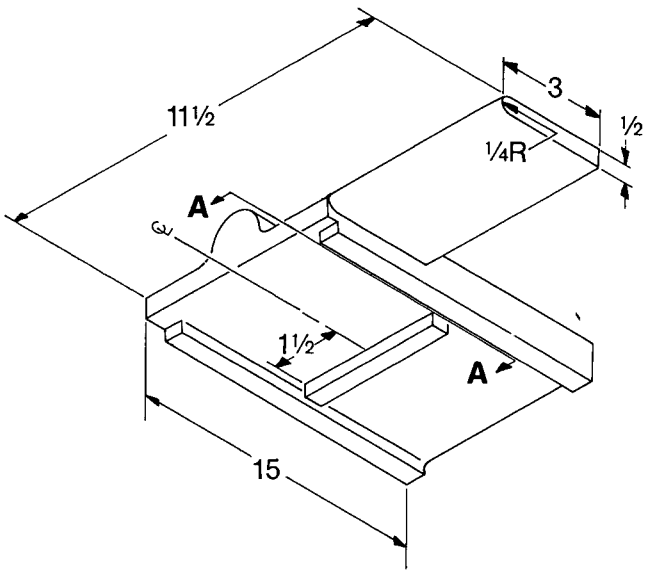
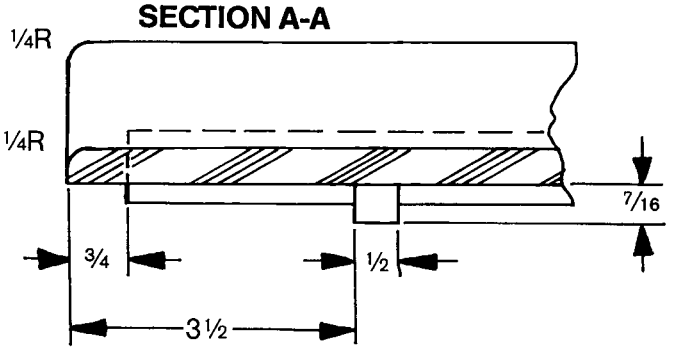
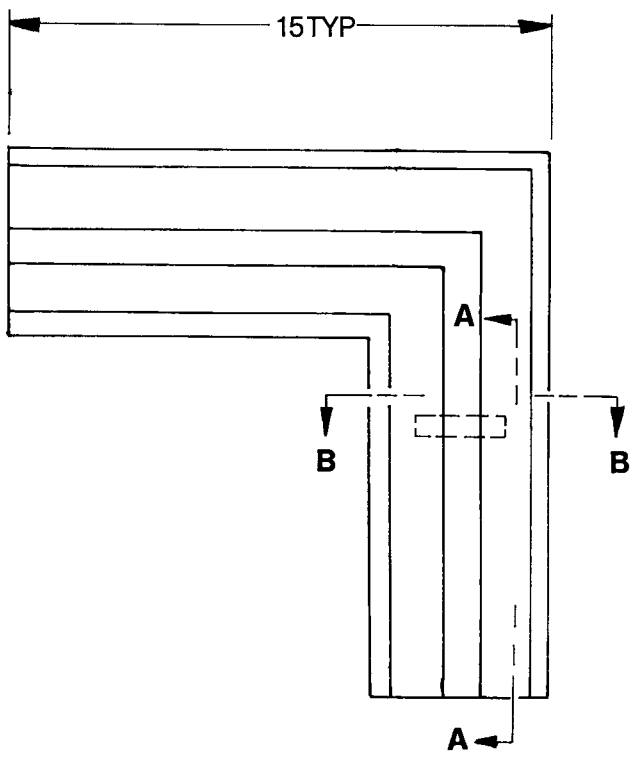


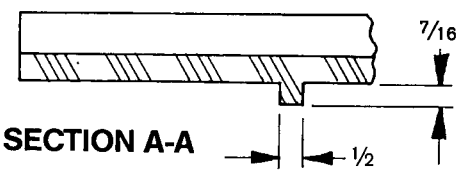
MOLD NO. 5169
AS SHOWN AND OPPOSITE

SECTION A-A

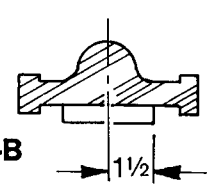




RADIAL GATE SEAL CORNER
MOLD NO. 4504
AS SHOWN AND OPPOSITE



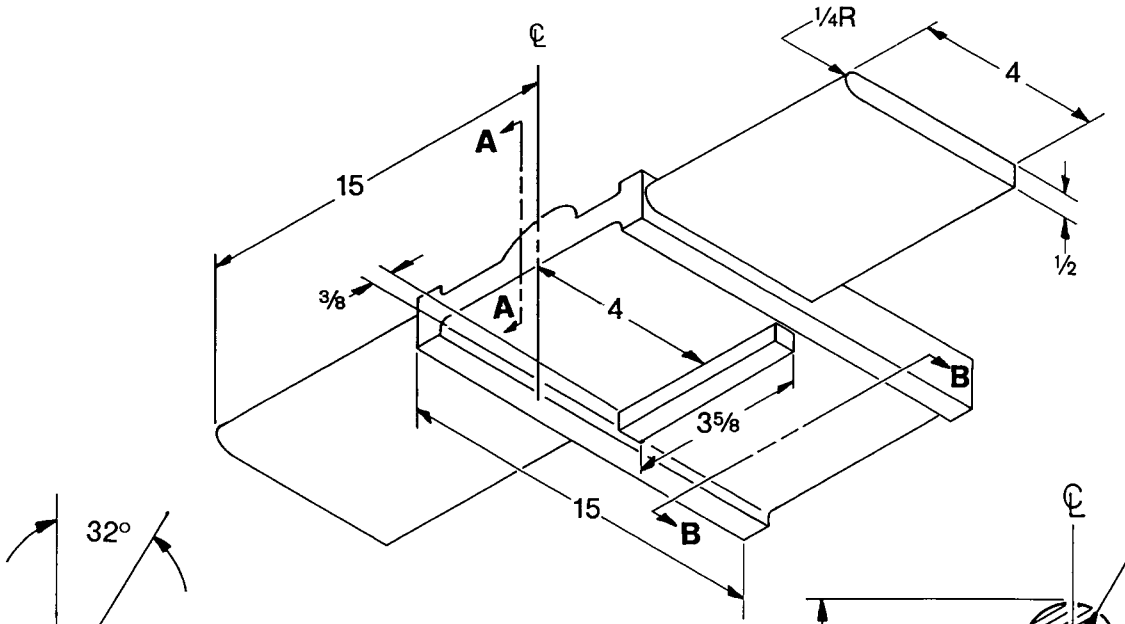
SECTION A-A

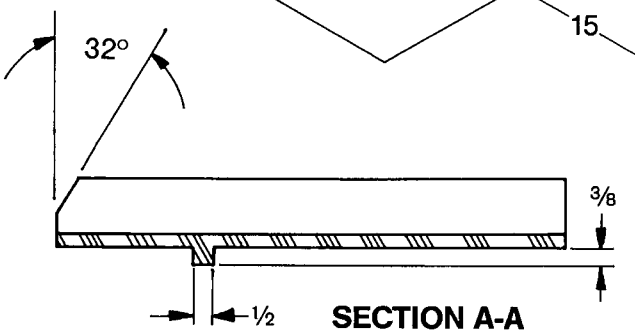


SECTION B-B

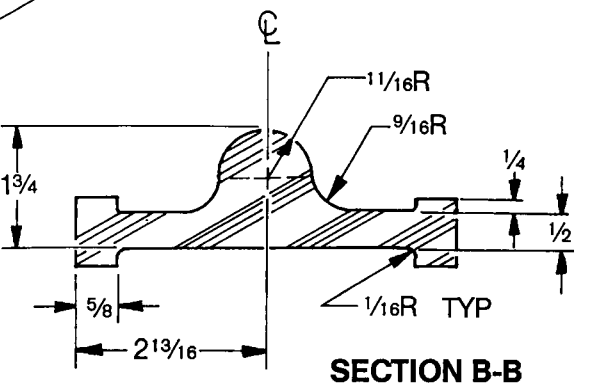
TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE
SEE MOLD NO. 4499, PAGE H-12

MOLD NO. 5019





SECTION A-A



SECTION B-B

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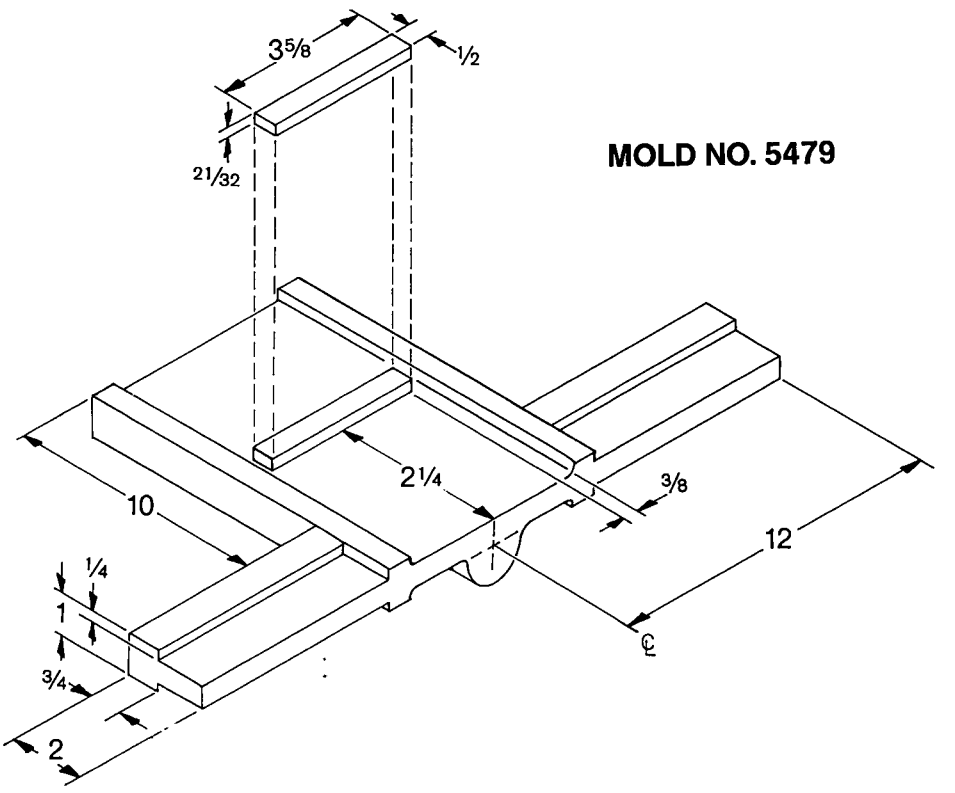
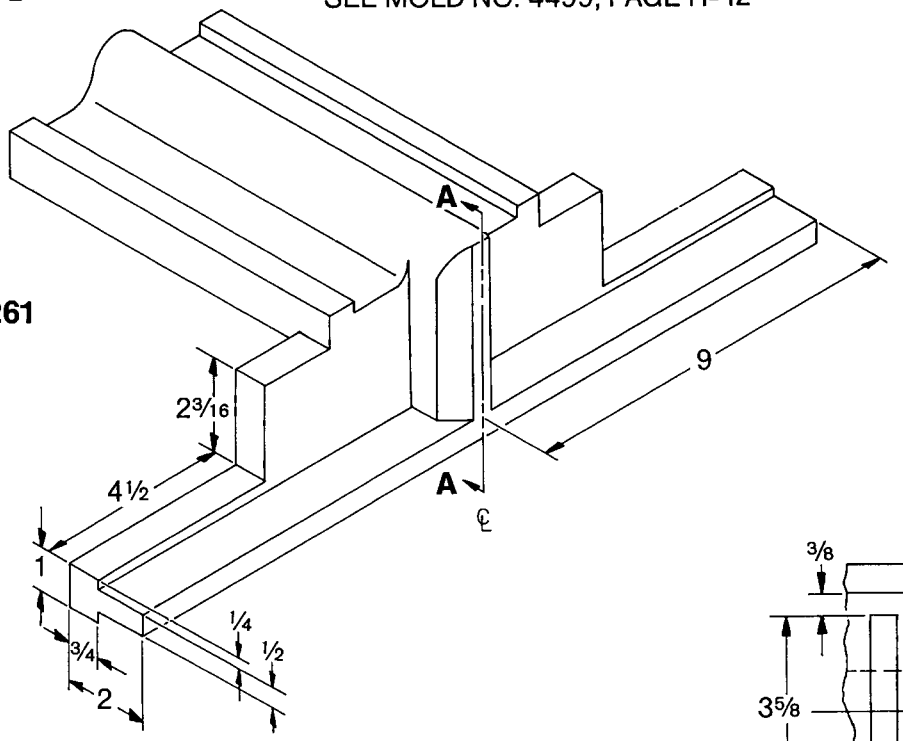
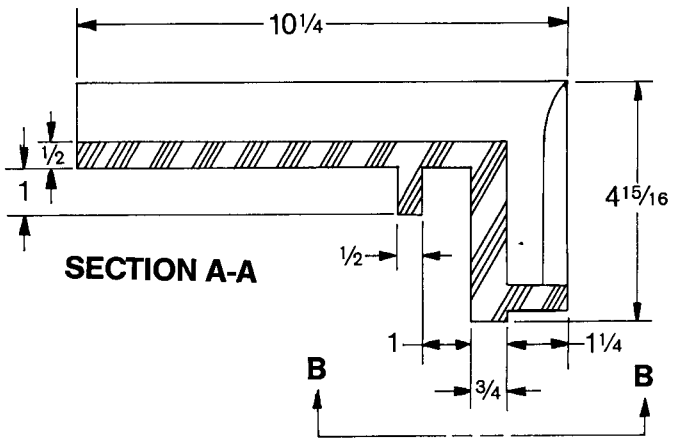


H-14

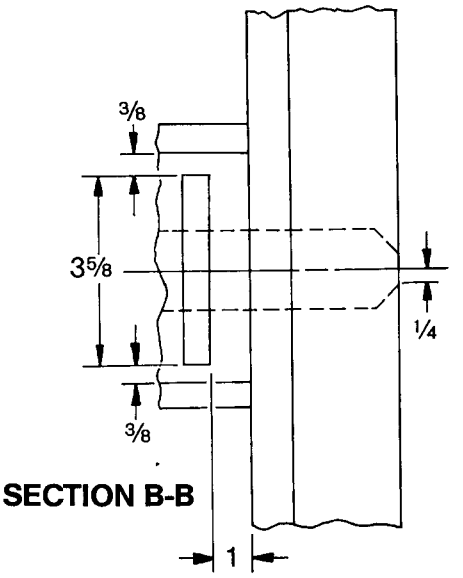
TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE
SEE MOLD NO. 4499, PAGE H-12

MOLD NO. 6261

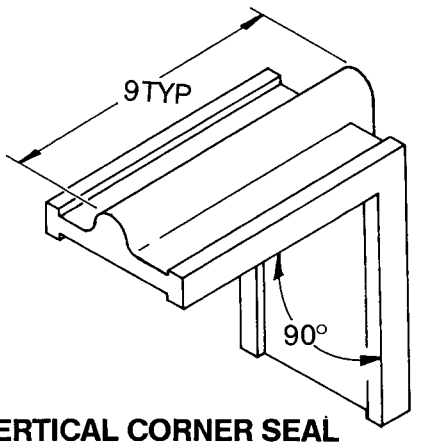




SECTION A-A



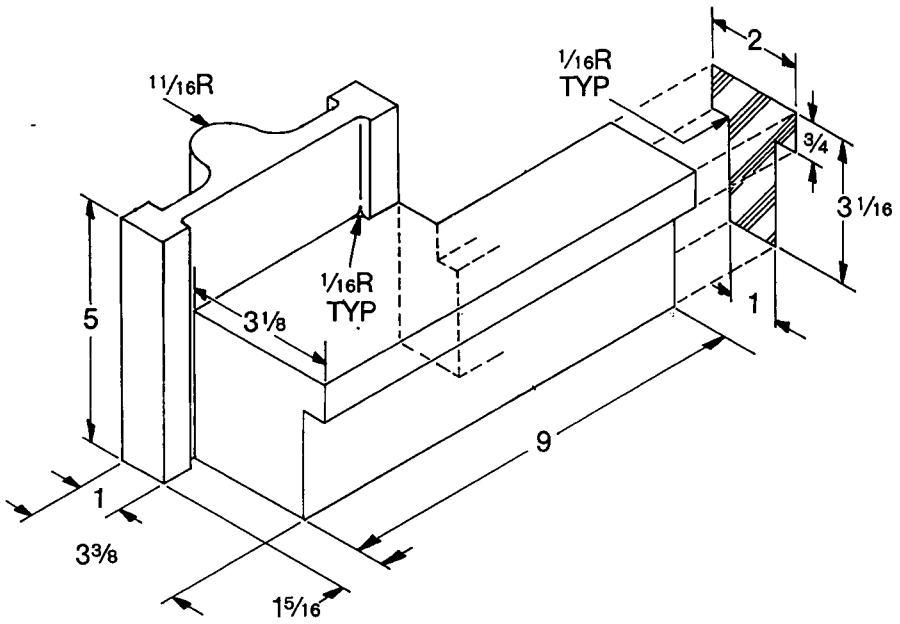
SECTION B-B

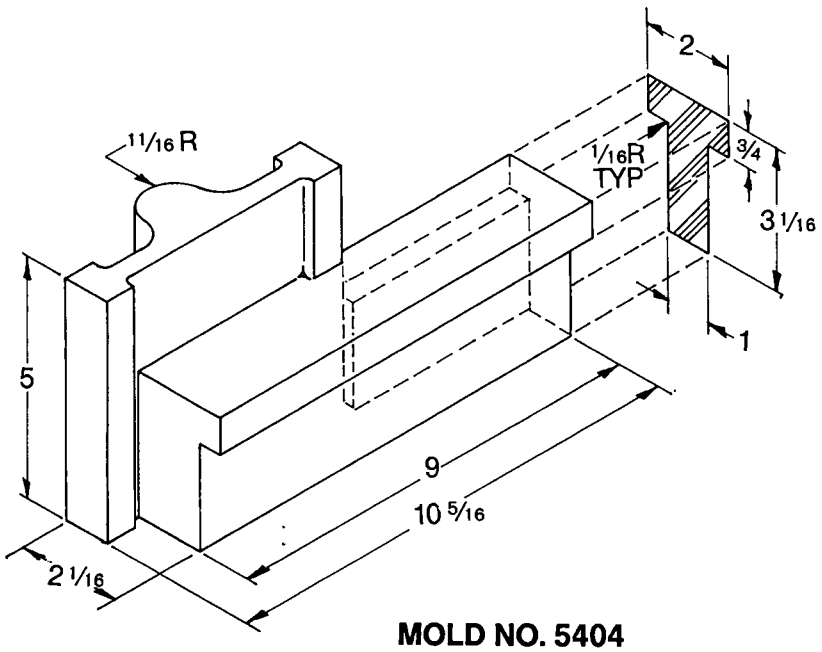


VERTICAL CORNER SEAL
MOLD NO. 6609

TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE
SEE MOLD NO. 4499, PAGE H-12

MOLD NO. 5753
AS SHOWN AND OPPOSITE

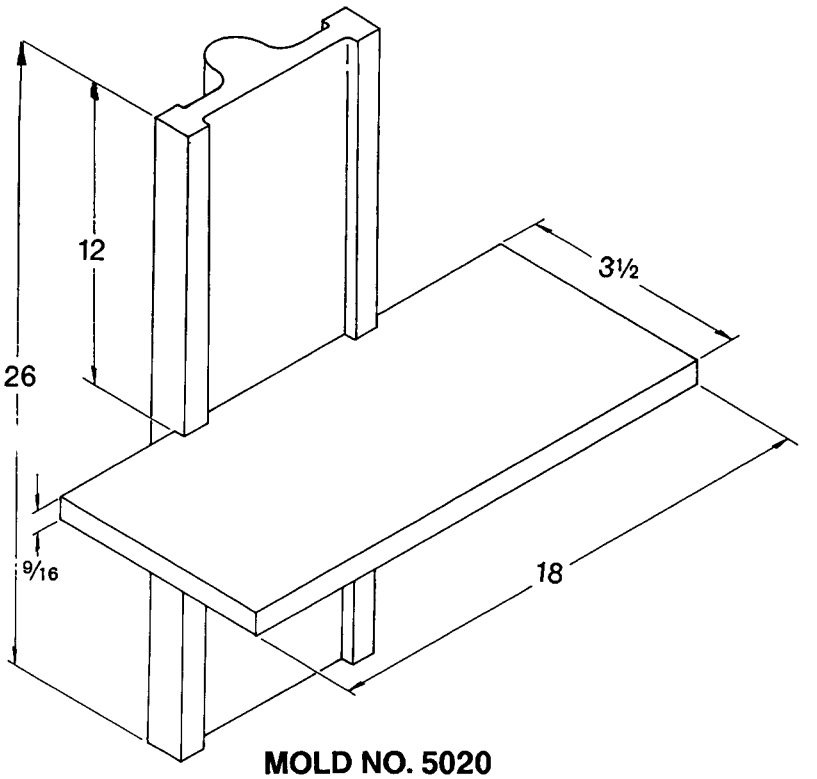




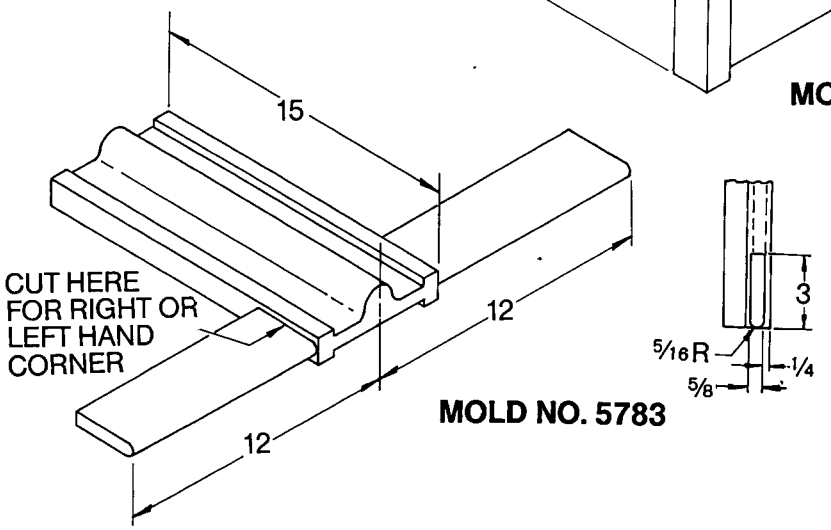
MOLD NO. 5404
AS SHOWN AND OPPOSITE

H-16

TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE
SEE MOLD NO. 4499, PAGE H-12



MOLD NO. 5020



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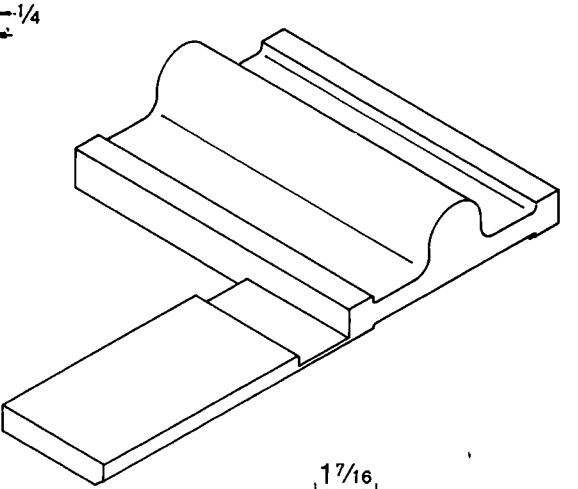
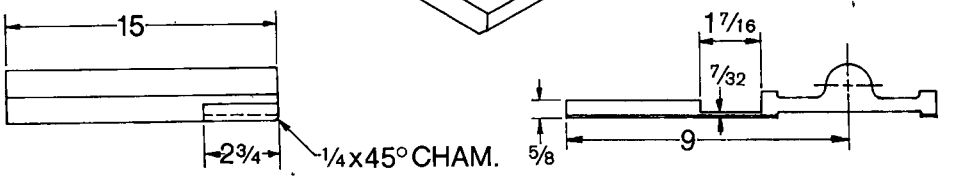
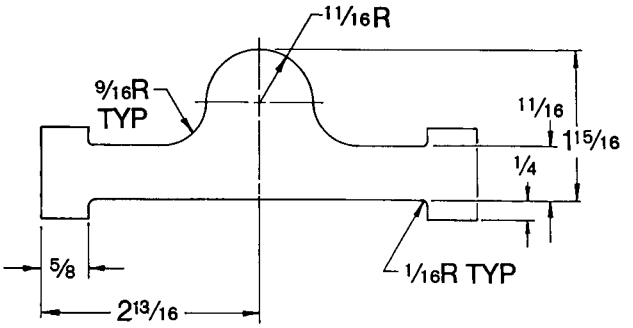


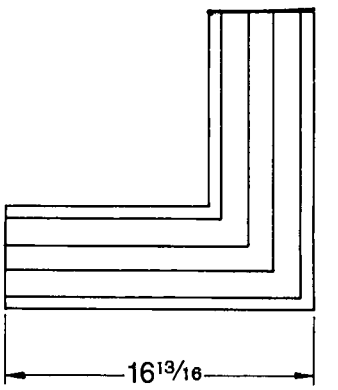


MOLD NO. 6451
AS SHOWN AND OPPOSITE

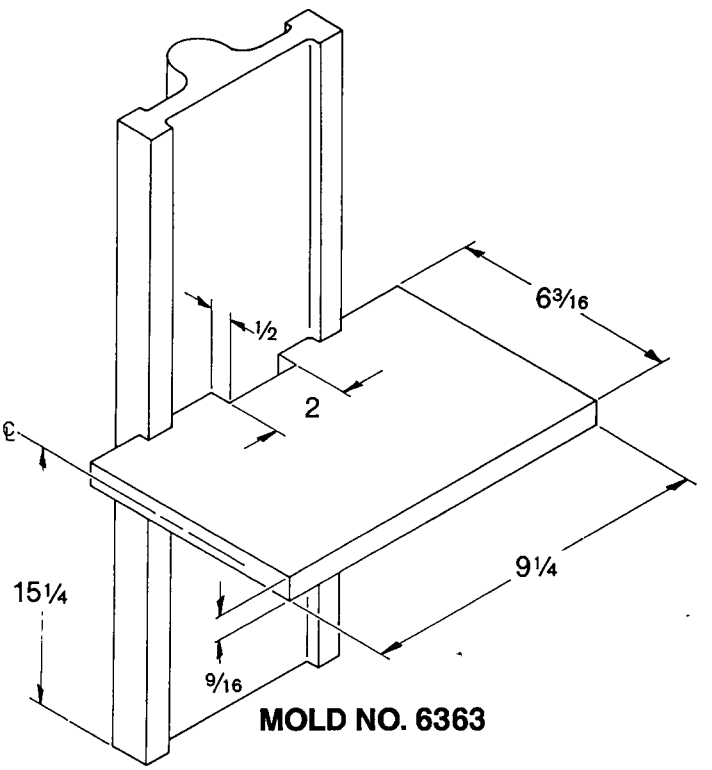


MOLD NO. 6360

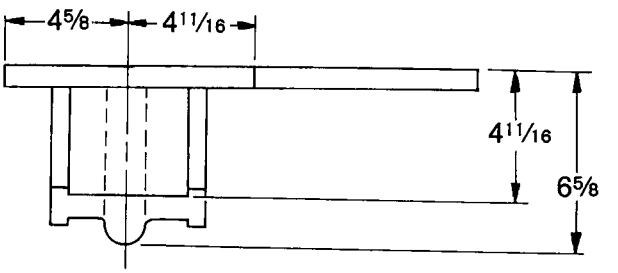
TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE



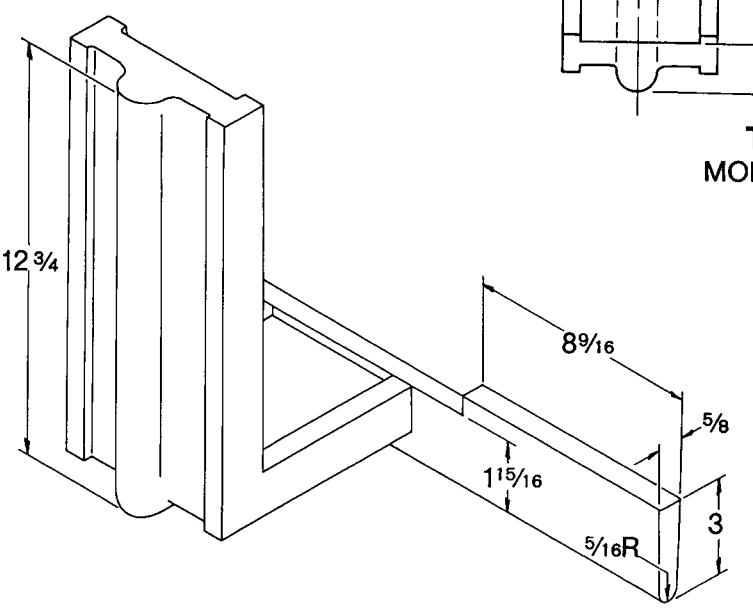
CORNER MOLD NO. 6361



MOLD NO. 6363

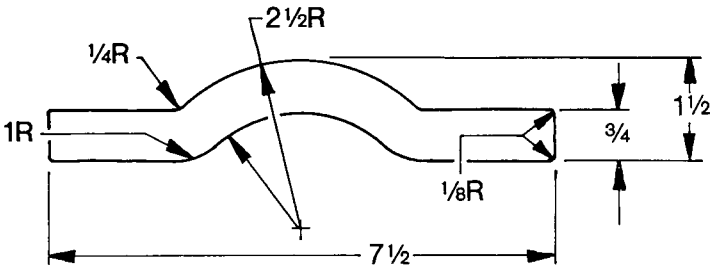


TOP VIEW
MOLD NO. 6362

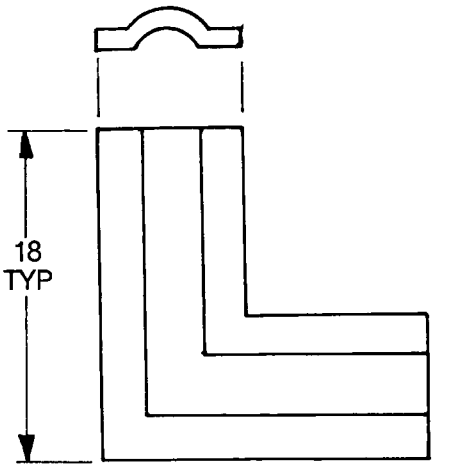


MOLD NO. 6362
BOTTOM CORNER SEAL
AS SHOWN AND OPPOSITE

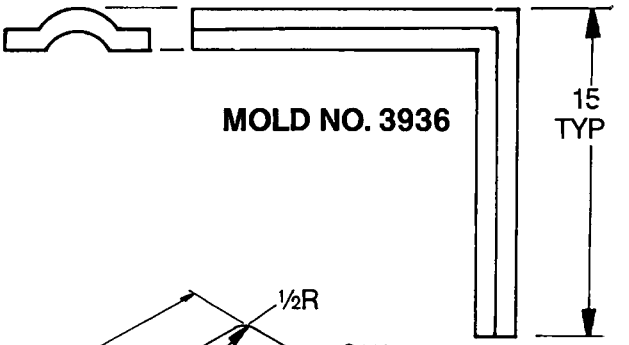
H-18



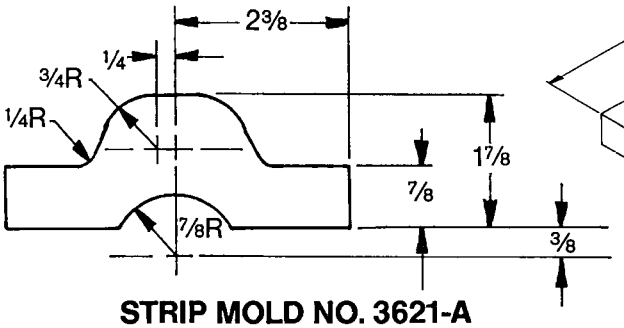
STRIP MOLD NO. 3885
TYPICALCROSS SECTION FOR
MOLDS 3935 & 3936



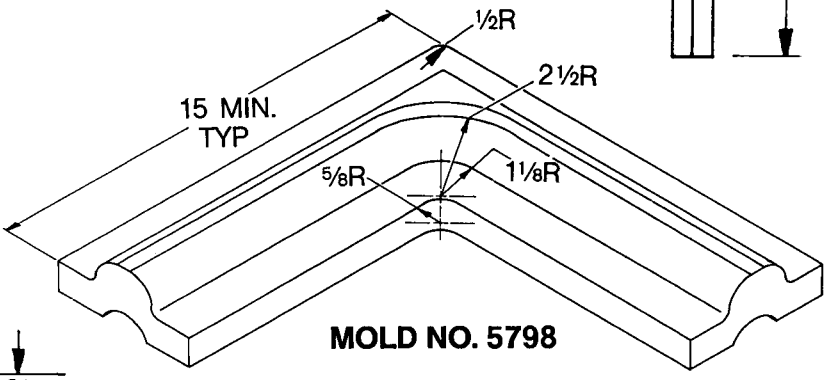
MOLD NO. 3935



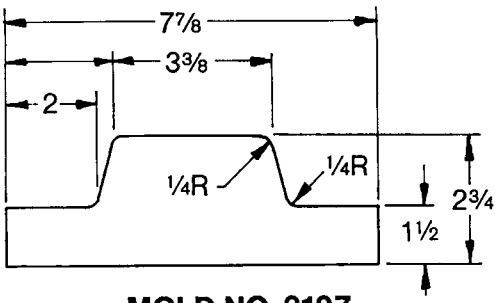
MOLD NO. 3936



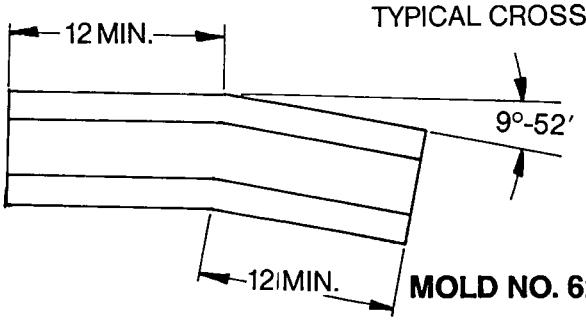
STRIP MOLD NO. 3621-A



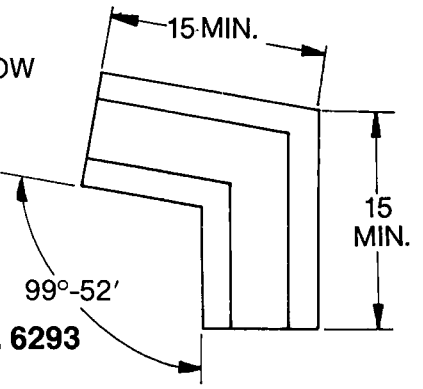
MOLD NO. 5798



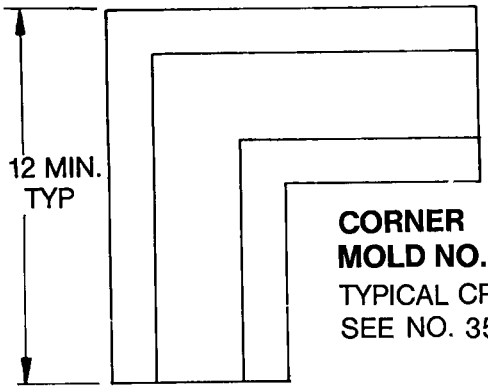
MOLD NO. 3197
TYPICAL CROSS SECTION FOR MOLDS BELOW



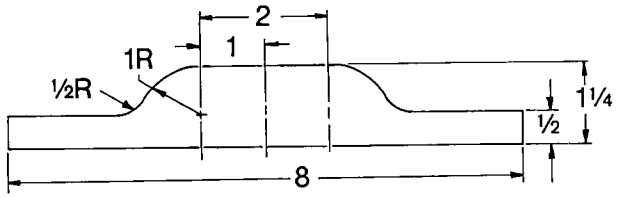
MOLD NO. 6292



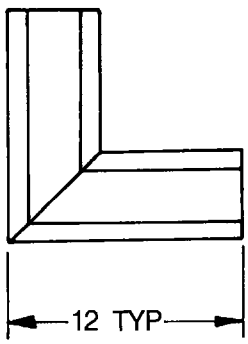
MOLD NO. 6293



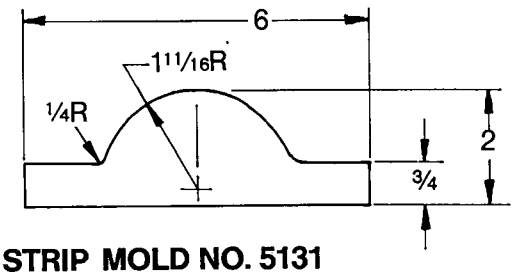
CORNER
MOLD NO. 6954
TYPICAL CROSS SECTION
SEE NO. 3538 AT RIGHT



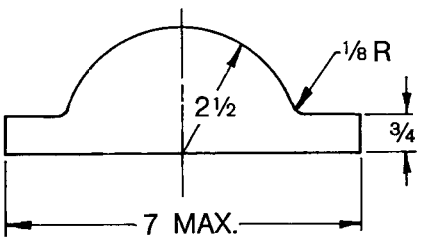
STRIP MOLD NO. 3538



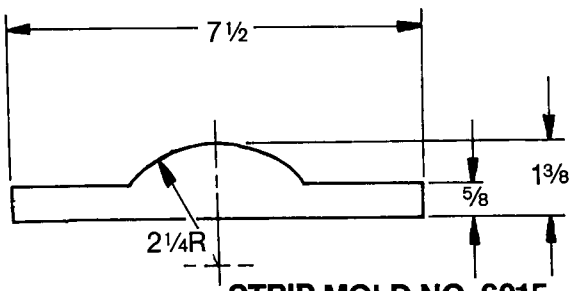
CORNER MOLD NO. 6251
TYPICAL CROSS SECTION SEE
NO. 5131 AT RIGHT



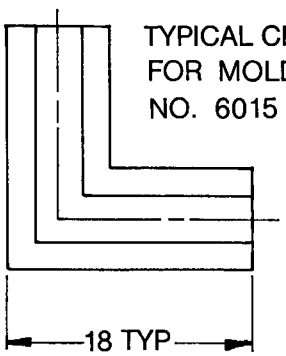
STRIP MOLD NO. 5131



STRIP MOLD NO. 5832

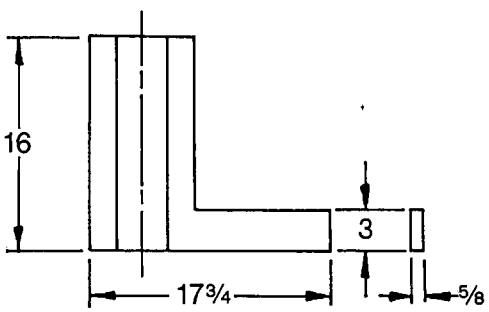


STRIP MOLD NO. 6015



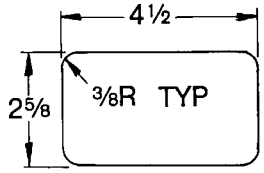
TYPICAL CROSS SECTION
FOR MOLDS BELOW PER
NO. 6015 ABOVE

TOP CORNER MOLD NO. 6016

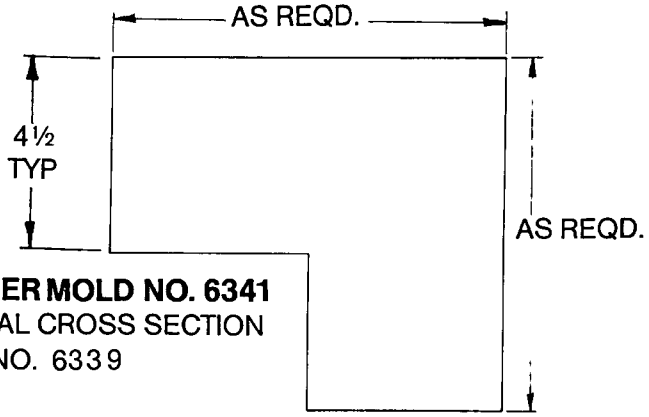


BOTTOM CORNER MOLD NO. 6017
AS SHOWN AND OPPOSITE

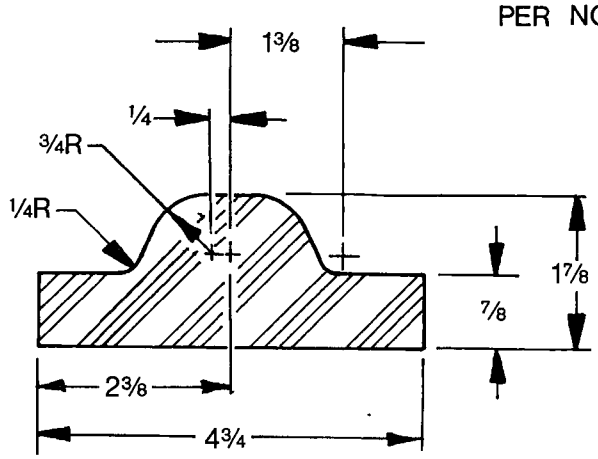
H-20



STRIP MOLD NO. 6339

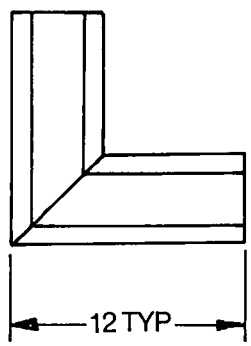


CORNER MOLD NO. 6341
TYPICAL CROSS SECTION
PER NO. 6339

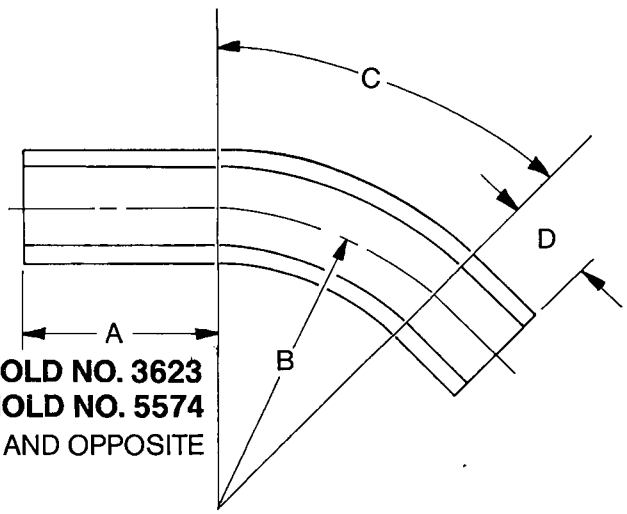


TYPICAL BULB CROSS SECTION
FOR ALL MOLDS BELOW

STRIP MOLD NO. 3621

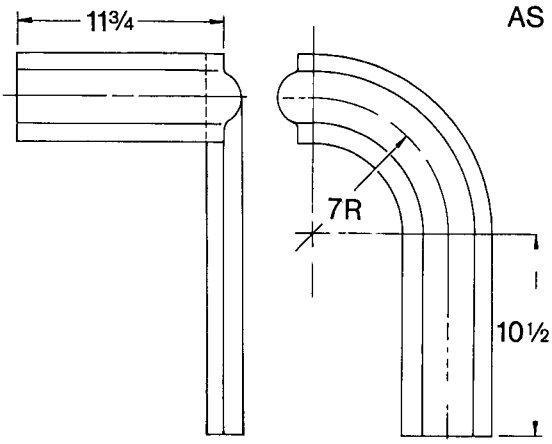


CORNER MOLD NO. 4561



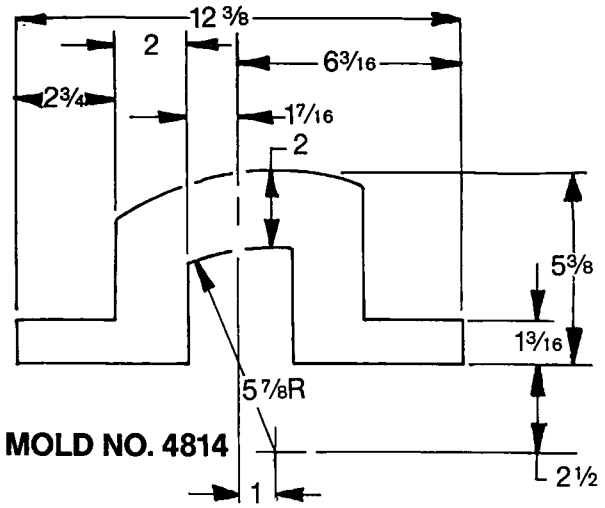
MOLD NO. 3623
MOLD NO. 5574
AS SHOWN AND OPPOSITE

MOLD NO.	A	B	C	D
3623	7½	13R	45°	3⅛
5574	8	7½R	45°	3

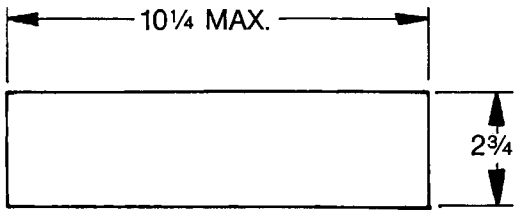


MOLD NO. 3634 & 3635
AS SHOWN AND OPPOSITE

ALL MOLDS ON THIS PAGE WILL PROVIDE STRIP LENGTHS AS REQUIRED, EXCEPT AS NOTED.

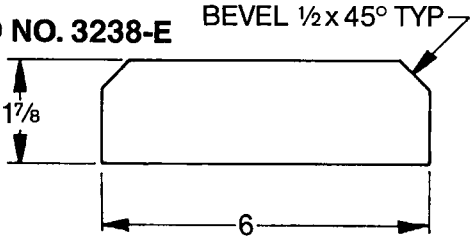


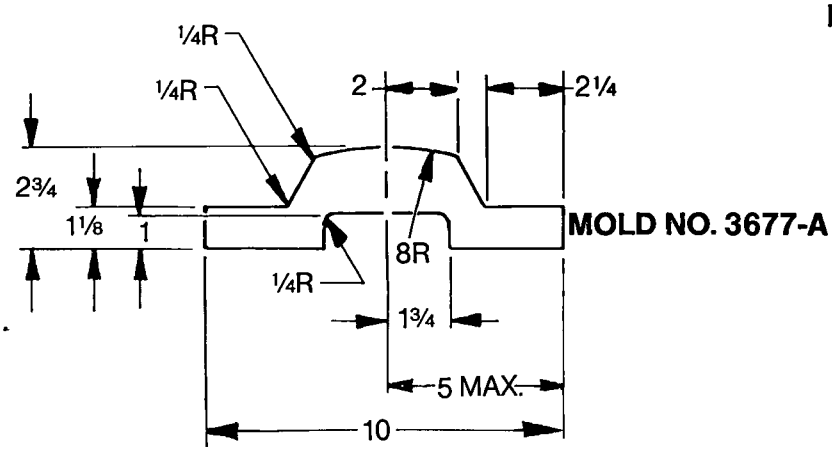
MOLD NO. 4814



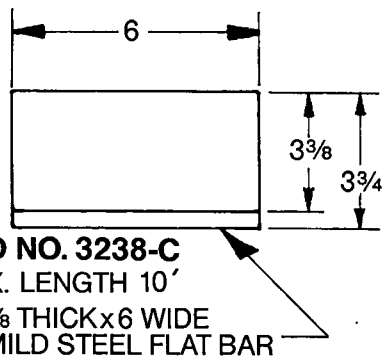
MOLD NO. 5859

MOLD NO. 3238-E

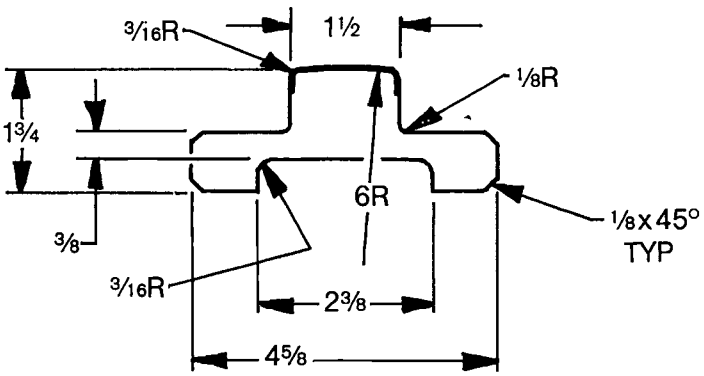




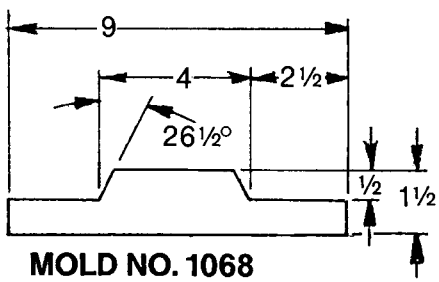
MOLD NO. 3677-A



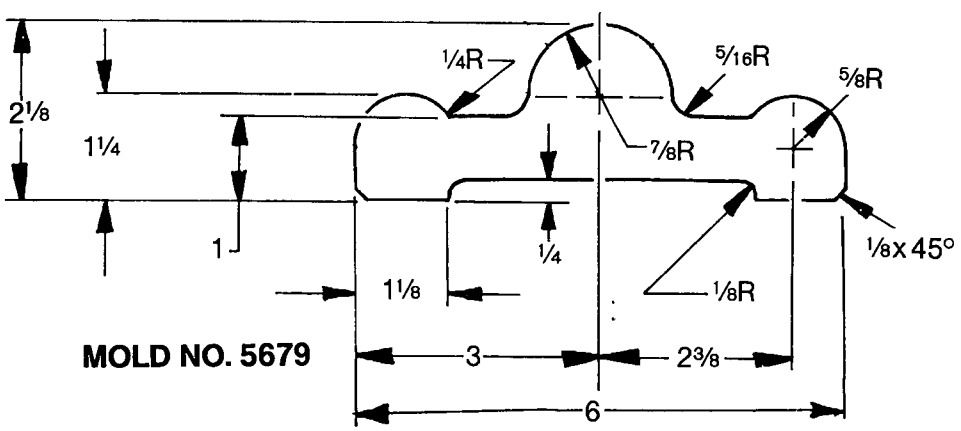
MOLD NO. 3238-C
MAX. LENGTH 10'
3/8 THICK x 6 WIDE
MILD STEEL FLAT BAR



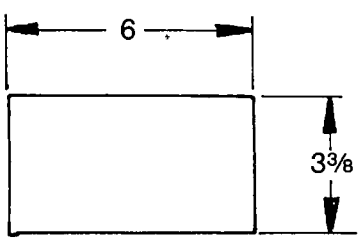
MOLD NO. 5150



MOLD NO. 1068



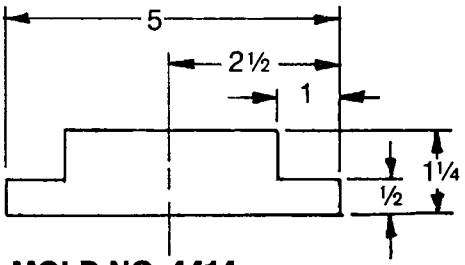
MOLD NO. 5679



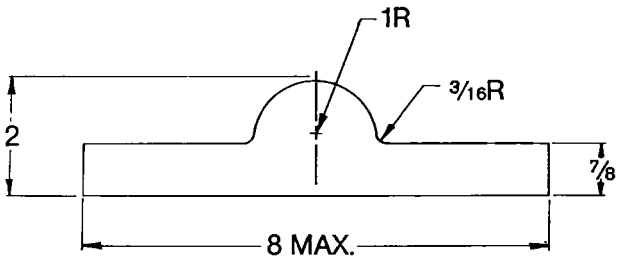
MOLD NO. 3238-D

H-22

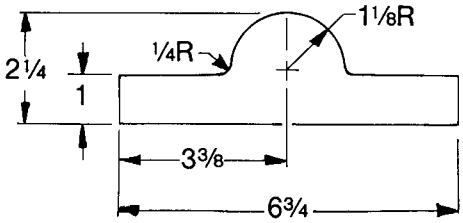
ALL MOLDS ON THIS PAGE WILL PROVIDE STRIP LENGTHS AS REQUIRED.



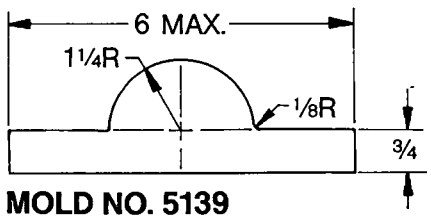
MOLD NO. 4414



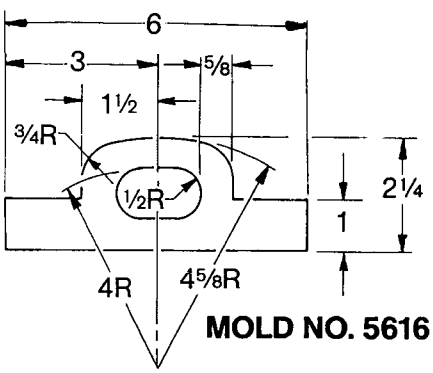
MOLD NO. 6800



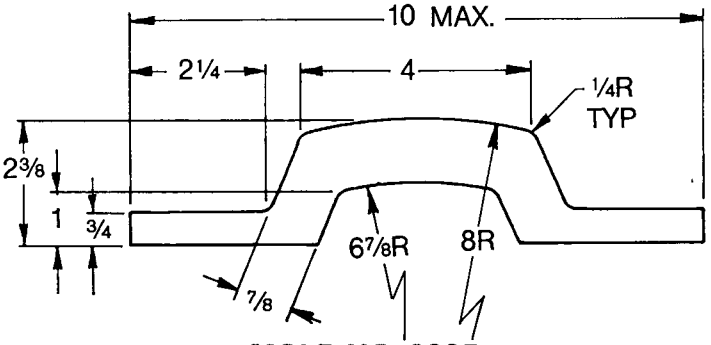
MOLD NO. 5569



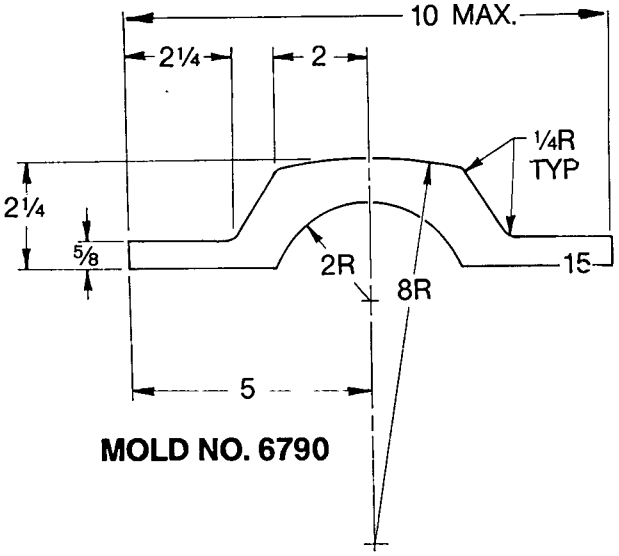
MOLD NO. 5139



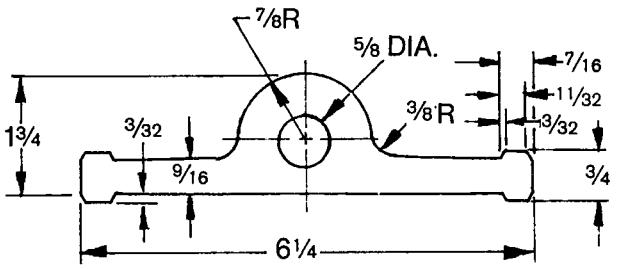
MOLD NO. 5616



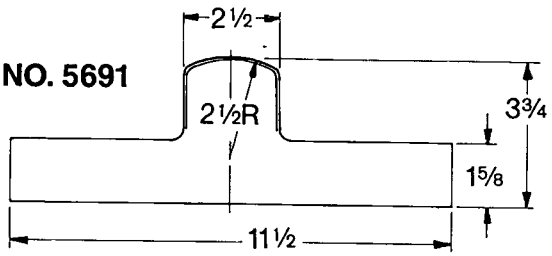
MOLD NO. 6835



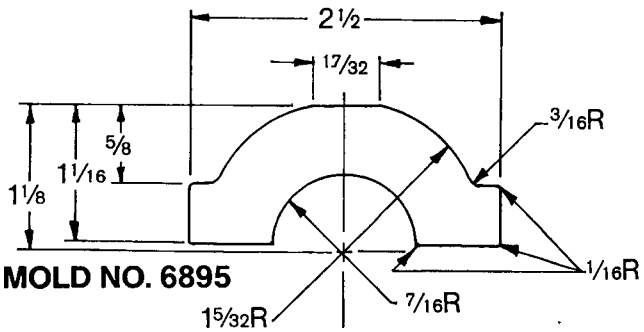
MOLD NO. 6790



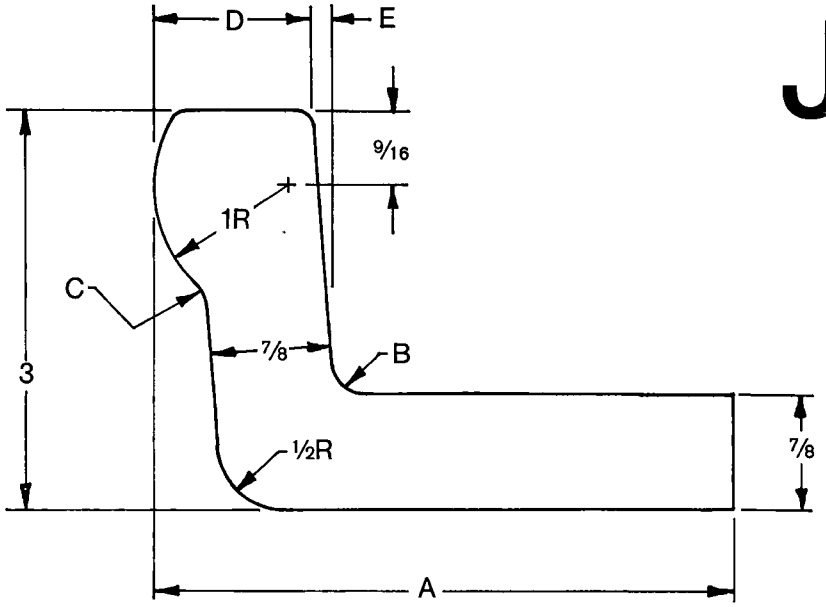
MOLD NO. 4260



MOLD NO. 5691

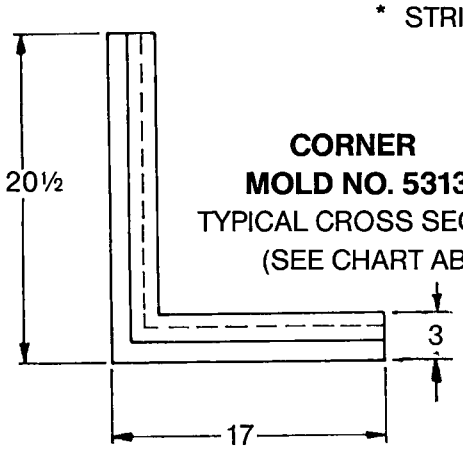


MOLD NO. 6895

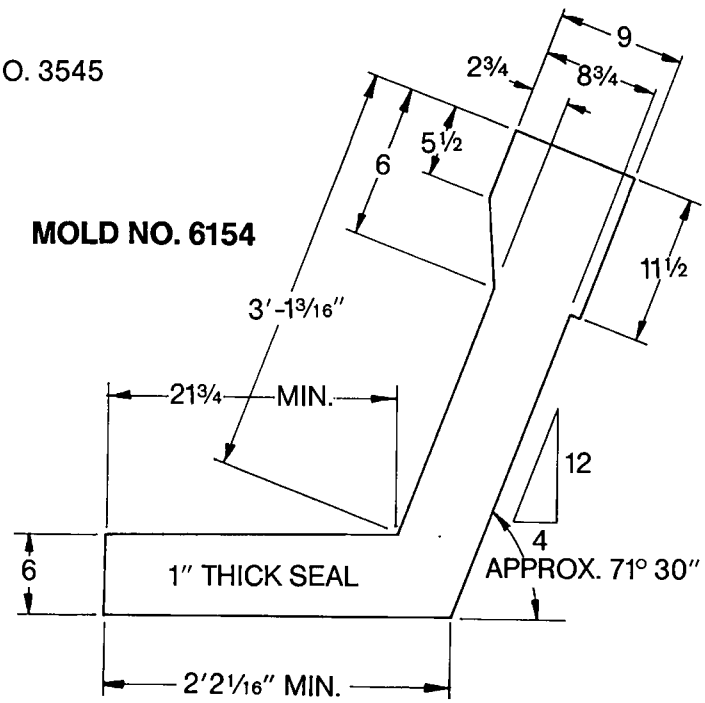


MOLD NO.	A	B	C	D	E
5245 *	4 3/4	1/4R	1/4R	1 3/16	1/8
3545 *	4 5/16	1/4R	1/4R	1 3/16	1/8
6404 *	4 3/4	9/32R	9/32R	1 7/32	3/4

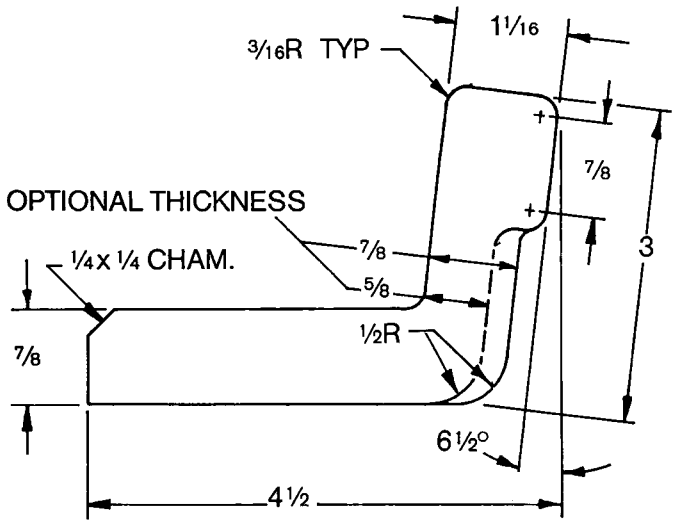
* STRIP MOLD



CORNER
MOLD NO. 5313
TYPICAL CROSS SECTION, MOLD NO. 3545
(SEE CHART ABOVE)

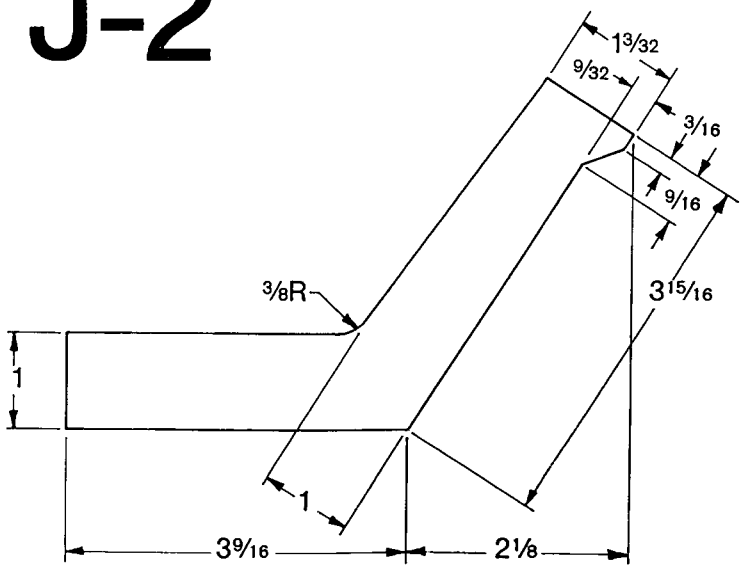


MOLD NO. 6154

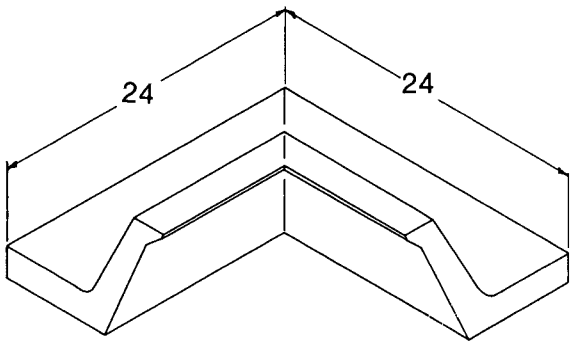


RADIAL GATE SEAL
STRIP MOLD NO. 4447

J-2

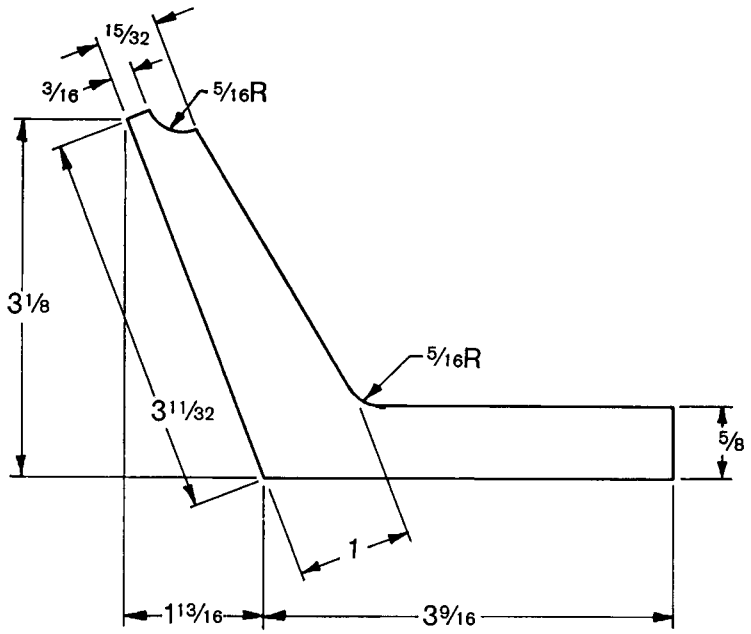


STRIP MOLD NO. 5039

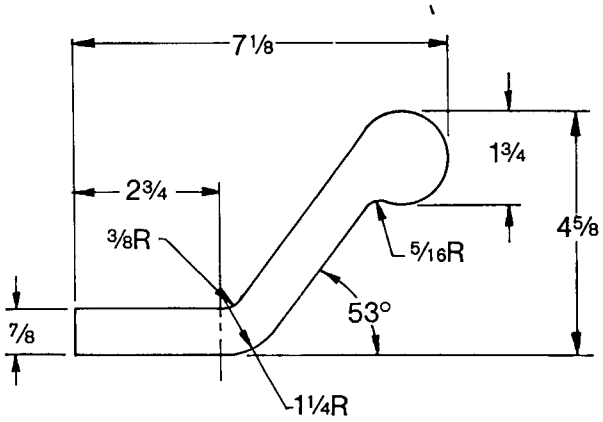


CORNER MOLD NO. 5051
TYPICAL CROSS SECTION
MOLD NO. 5039

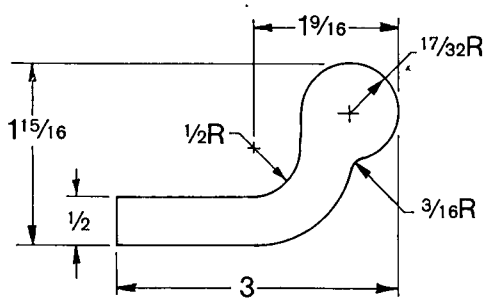
STRIP MOLD NO. 5037

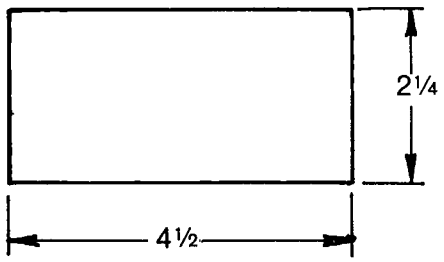


STRIP MOLD NO. 6151



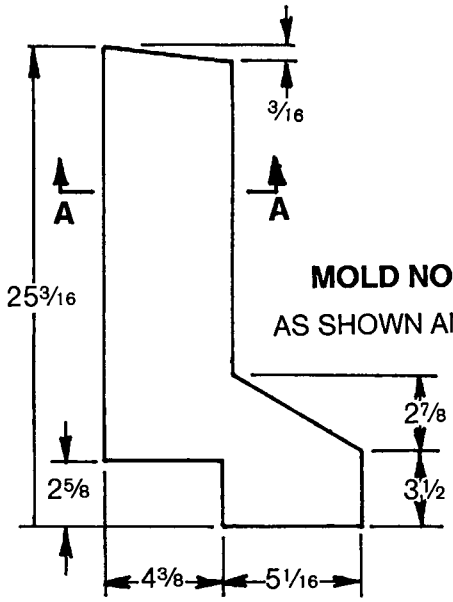
STRIP MOLD NO. 4474





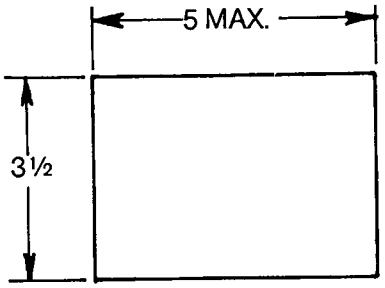
SECTION A-A

STRIP MOLD NO. 3519

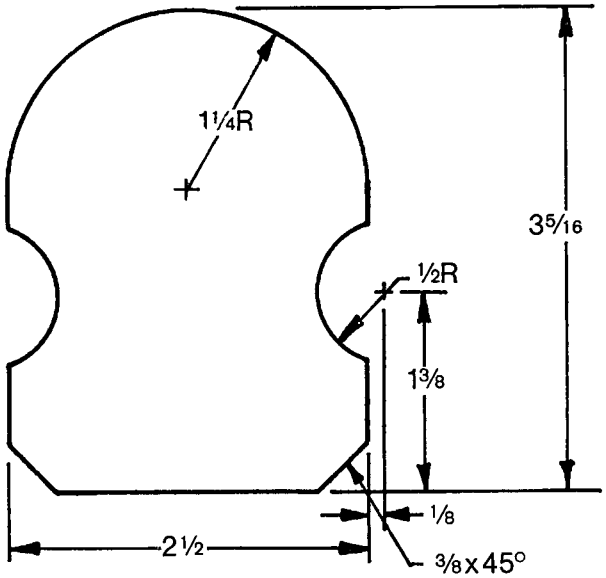


MOLD NO. 3592

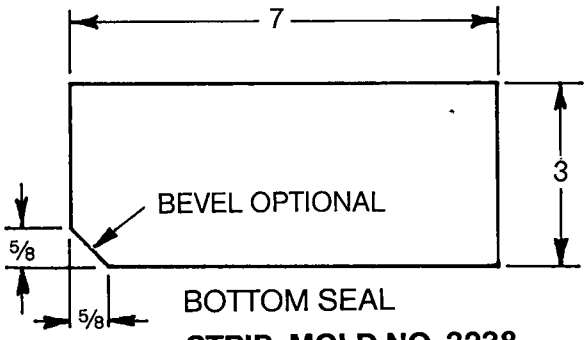
AS SHOWN AND OPPOSITE



STRIP MOLD NO. 3238-B

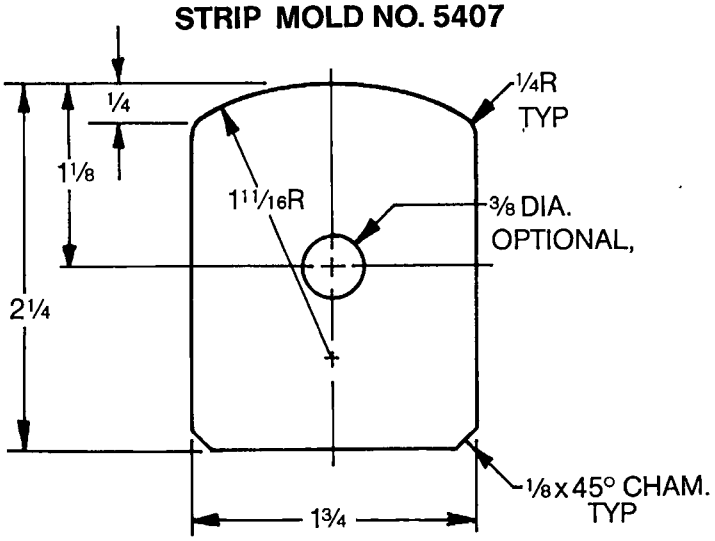


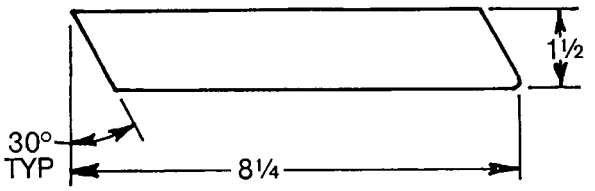
STRIP MOLD NO. 4613



STRIP MOLD NO. 3238

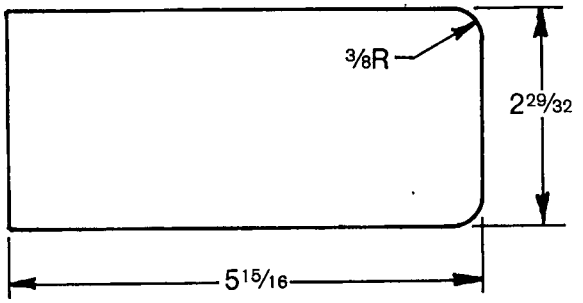
STRIP MOLD NO. 5407



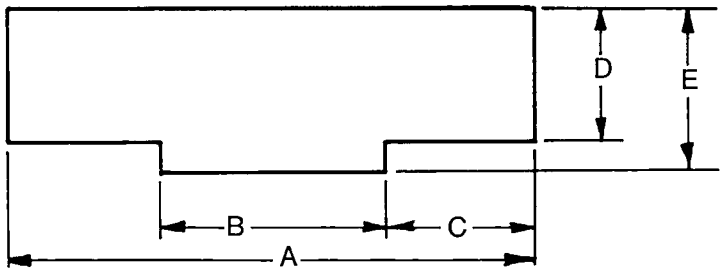


STRIP MOLD NO. 4477

STRIP MOLD NO. 3238-A

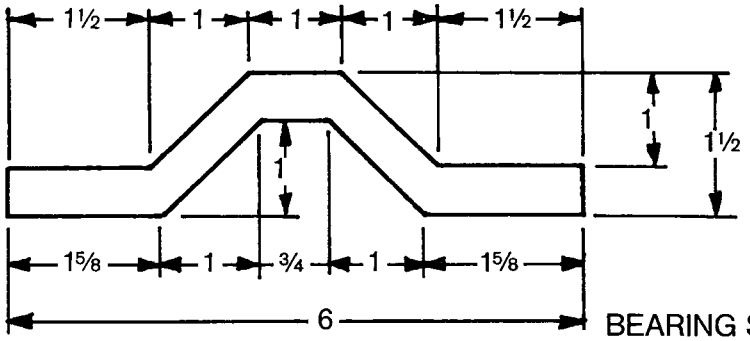


J-4



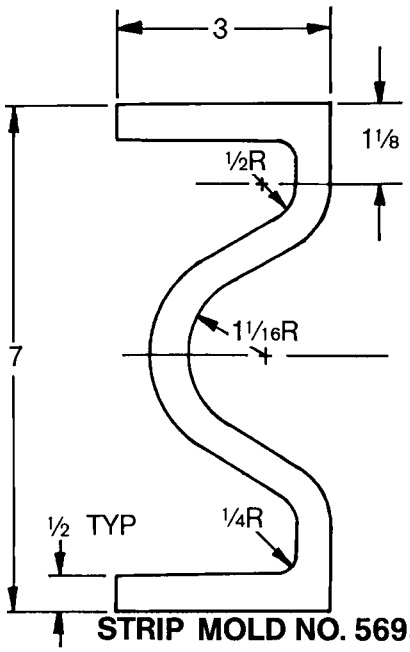
MOLD NO.	A	B	C	D	E
5052*	6 1/2	2 3/4	1 7/8	1 5/8	2
PART NO.79A4276*	1 5/8	3/4	7/16	5/8	1
PART NO.79A4262*	6	3 1/2	1 1/4	1	2 1/4

* SEAL STRIPS



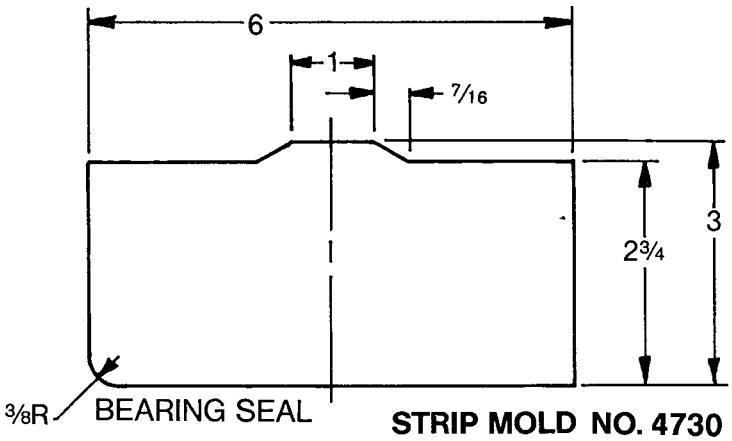
BEARING SEAL

STRIP MOLD NO. 5422

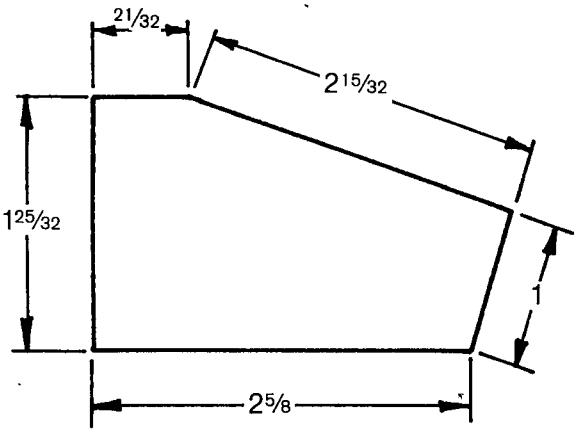


STRIP MOLD NO. 5695

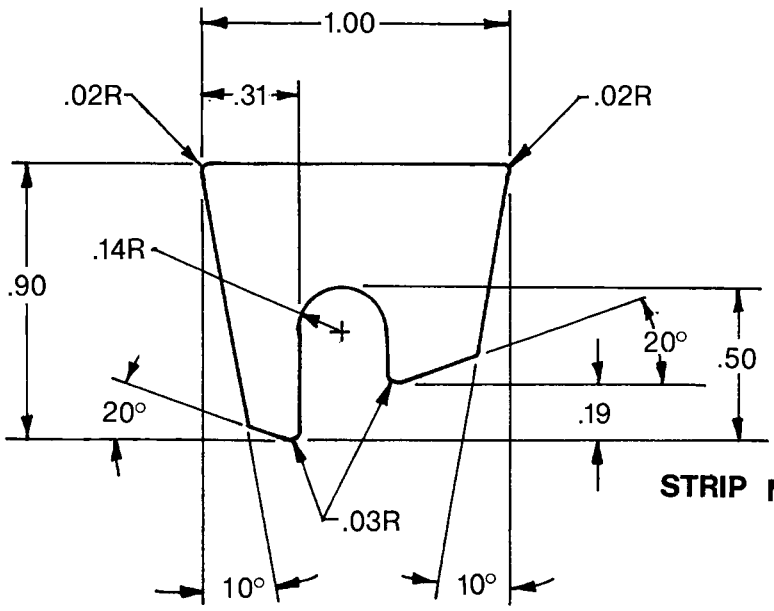
CROSS SECTION FOR CORNER MOLD NO. 5697, PAGE J-9



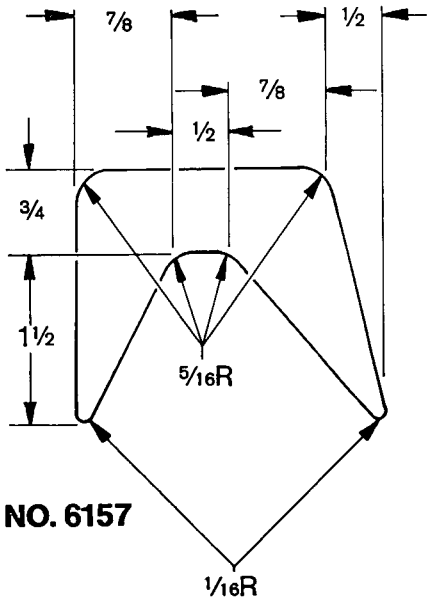
STRIP MOLD NO. 4730



STRIP MOLD NO. 3403

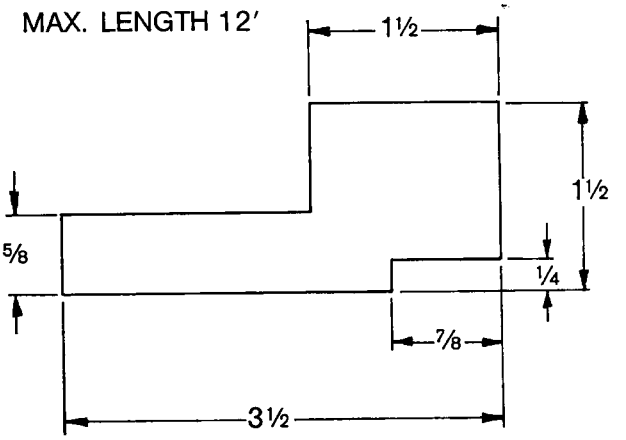


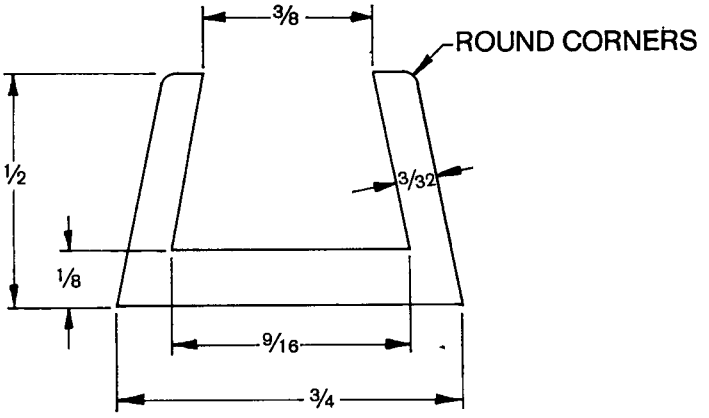
STRIP MOLD NO. 6049



STRIP MOLD NO. 6157

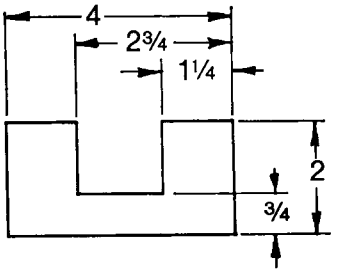
PART NO. 77A3566
NEOPRENE 60 DURO
MAX. LENGTH 12'

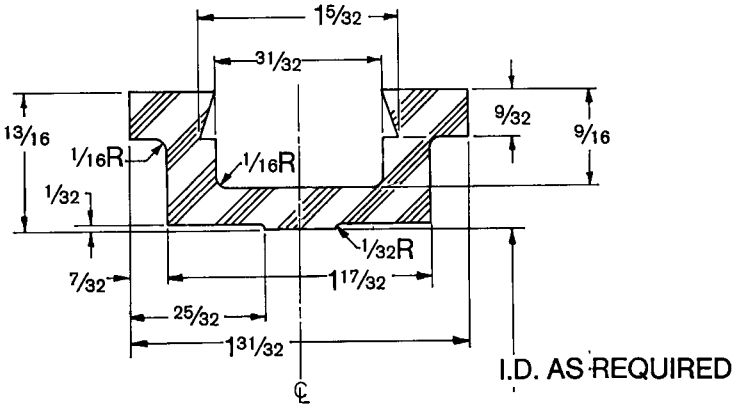




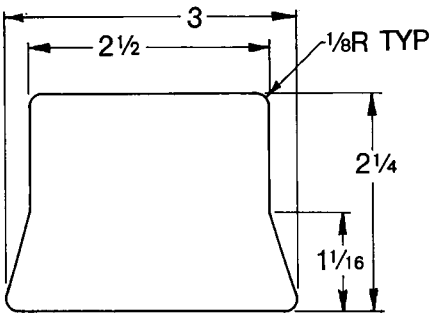
PART NO. 73D2019
EXTRUDED

STRIP MOLD NO. SB-4510-A





MOLD NO. 5375



STRIP MOLD NO. 6775

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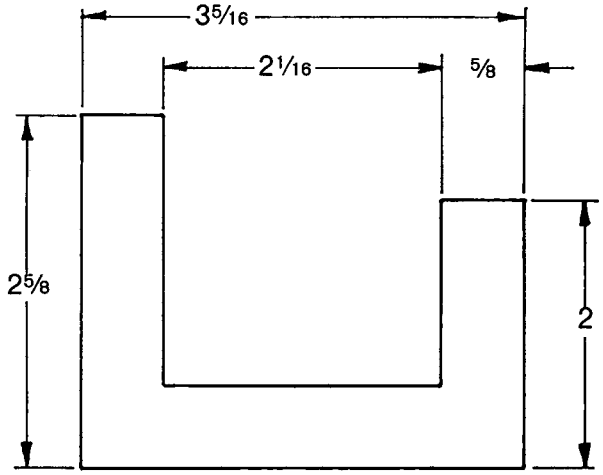
STRIP MOLD NO. 3547



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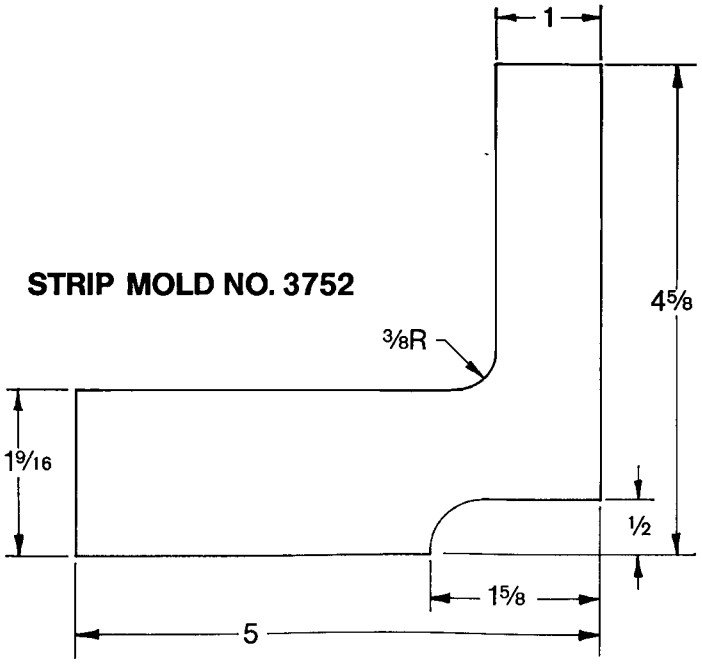
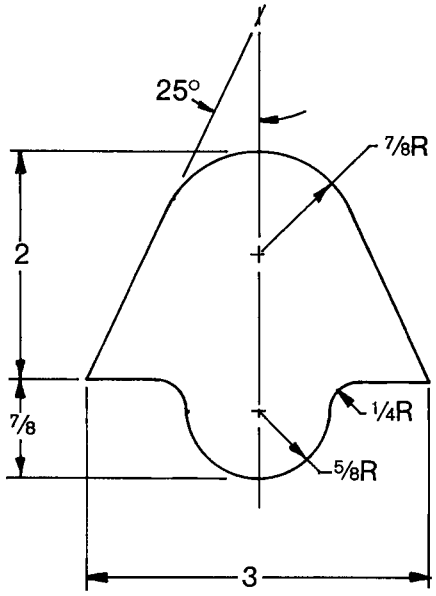
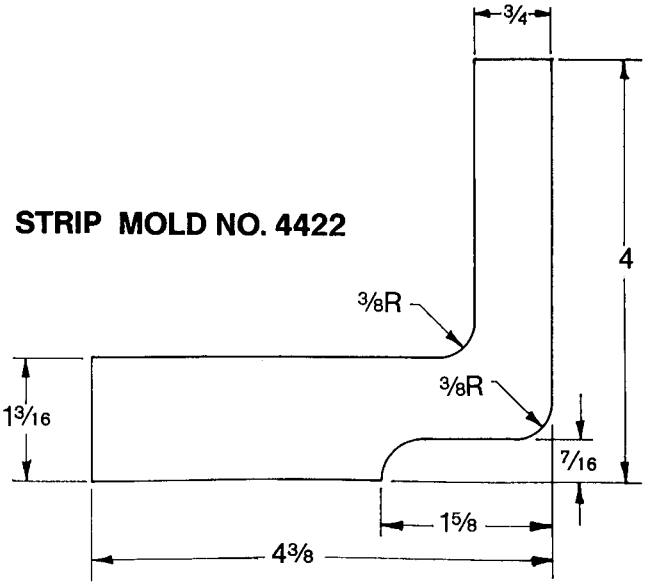
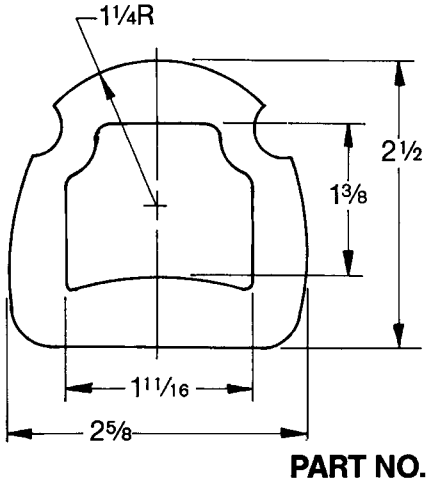




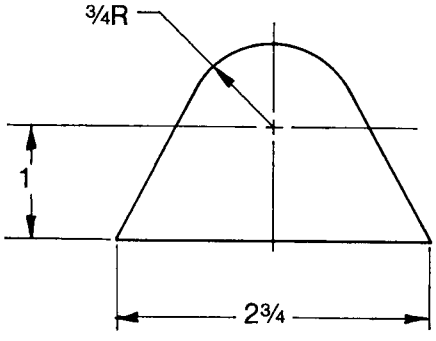
STRIP MOLD NO. 5807

STRIP MOLD NO. 4422



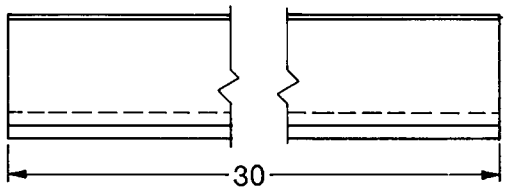


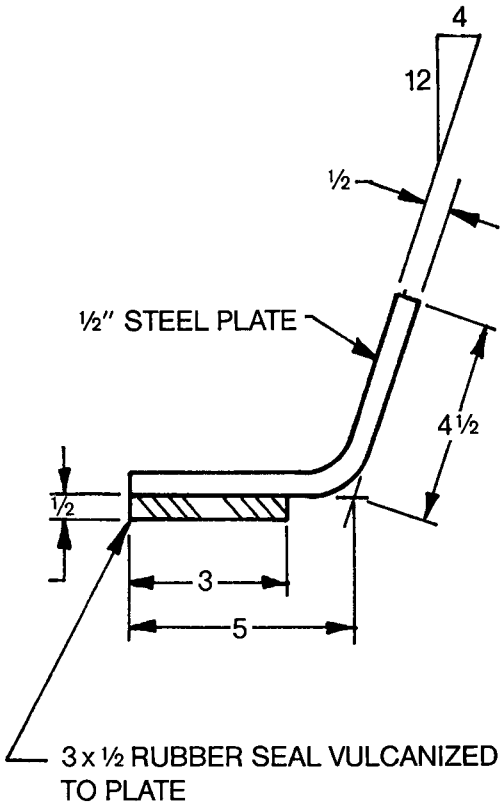
PART NO. 71D1397
EXTRUDED

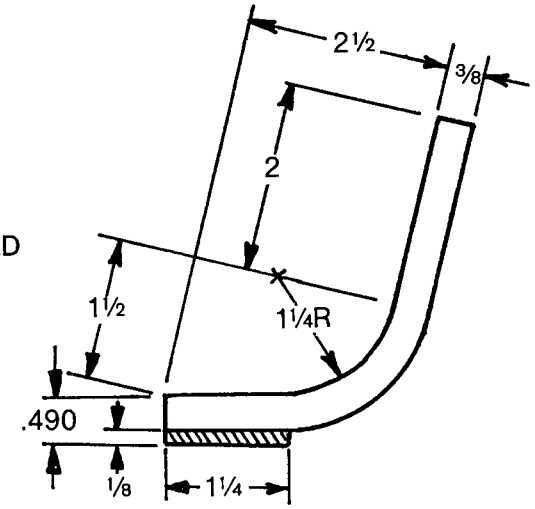


MOLD NO. 6524
LENGTH 60"

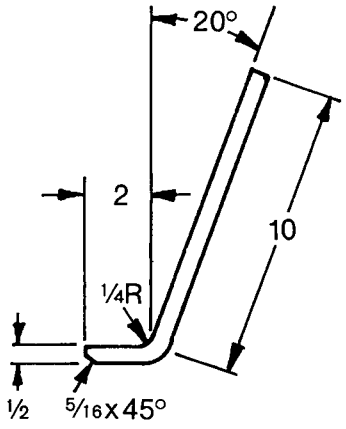
MOLD NO. 5141 & 5142
AS SHOWN AND OPPOSITE



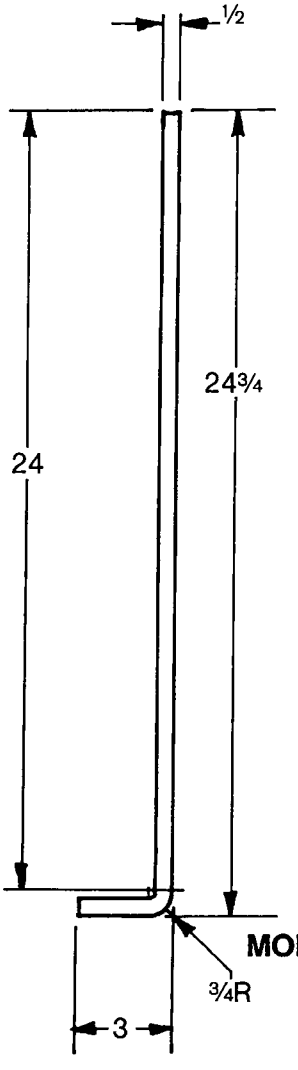




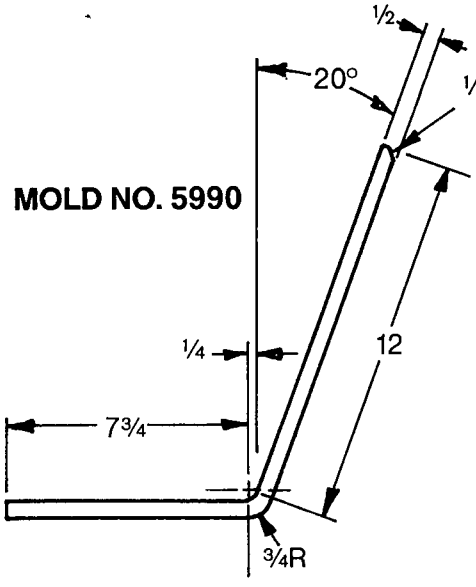
SEAL MOLD NO. 4591 BRASS CLAD
ALL RUBBER- FLUORO- CARBON OPTIONAL



MOLD NO. 5826

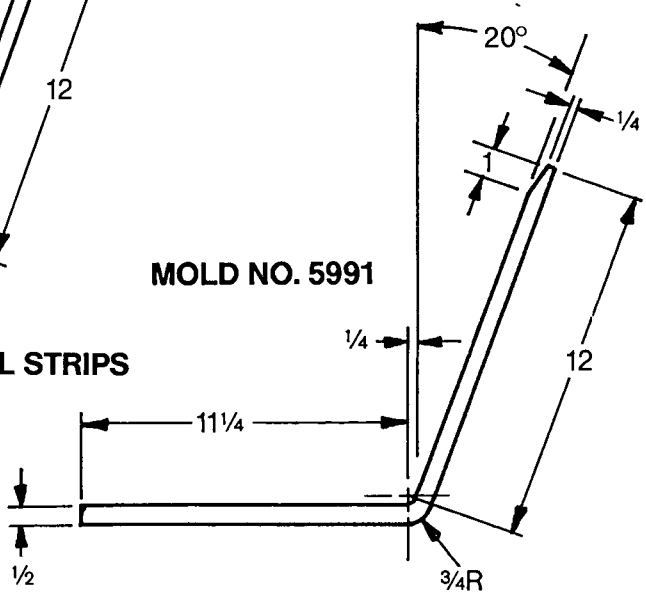


MOLD NO. 5992



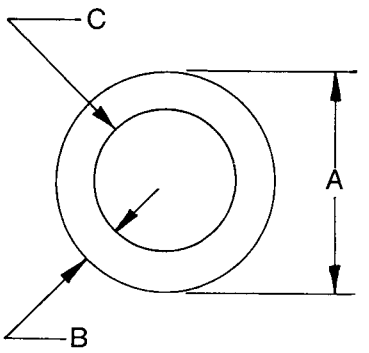
MOLD NO. 5990

SPECIAL FLAP SEAL STRIPS



MOLD NO. 5991

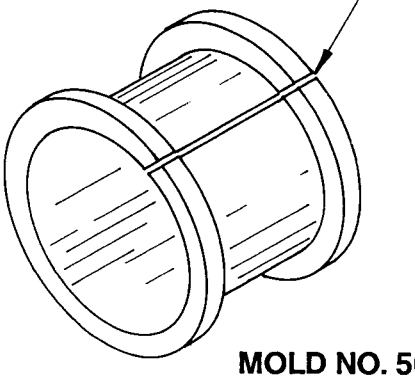
J-8



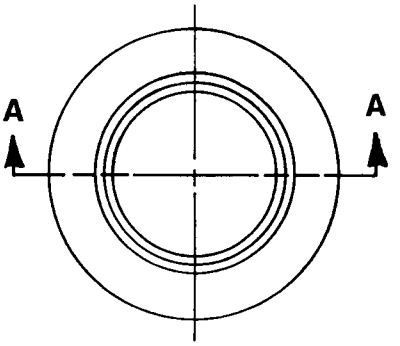
	A	B	C	MOLD	
	3/4	—	—	4275	90° CORNER, 6″ LEGS
	1 1/8	—	—	3599	90° CORNER, 18″ LEGS
	.906	—	—	3207	STRIP MOLD ALSO SPLICING MOLD
	1 1/8	—	—	3600	STRIP MOLD ALSO SPLICING MOLD
	3/4	—	—	4276	STRIP MOLD
	1	—	—	5894	STRIP MOLD
SOLID, ALL RUBBER, OPTIONAL	4	7/8*	2**	4094	STRIP MOLD
	3 1/2	5/8*	2**	4605	STRIP MOLD
	3 3/4	3/4*	2**	5748	STRIP MOLD
	1 3/4	5/16*	1**	6285	STRIP MOLD
	2.85	.33*	2**	4704	STRIP MOLD

**MAX. *MIN.

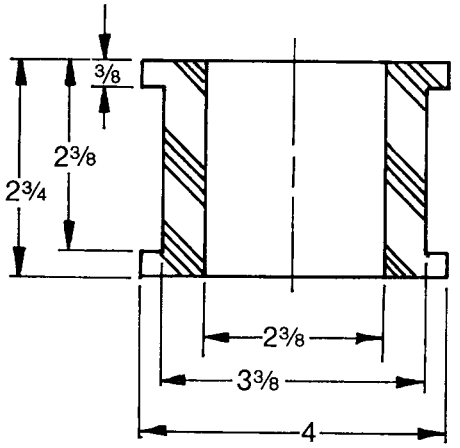
SPLIT ONE SIDE AFTER MOLDING FOR INSTALLATION

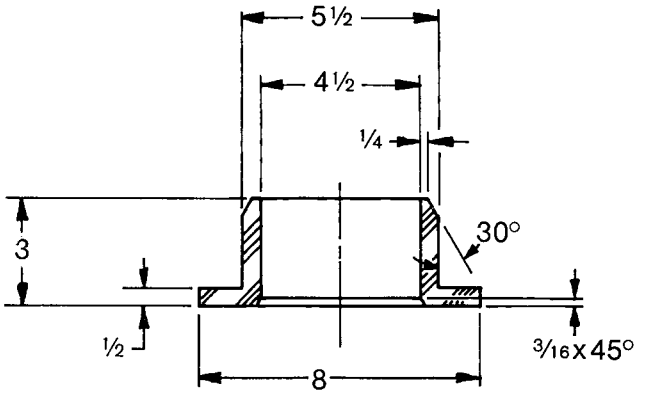


MOLD NO. 5688

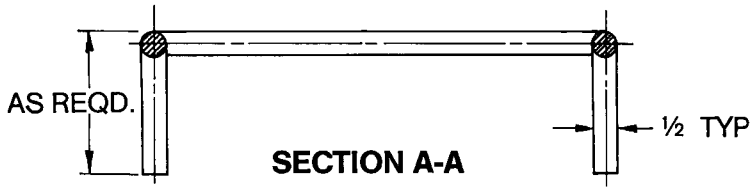


MOLD NO. 5566

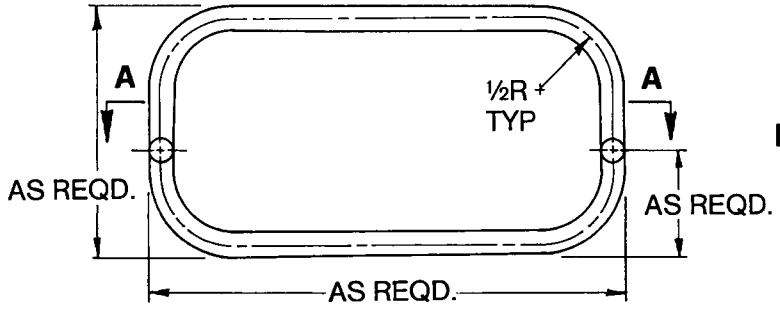




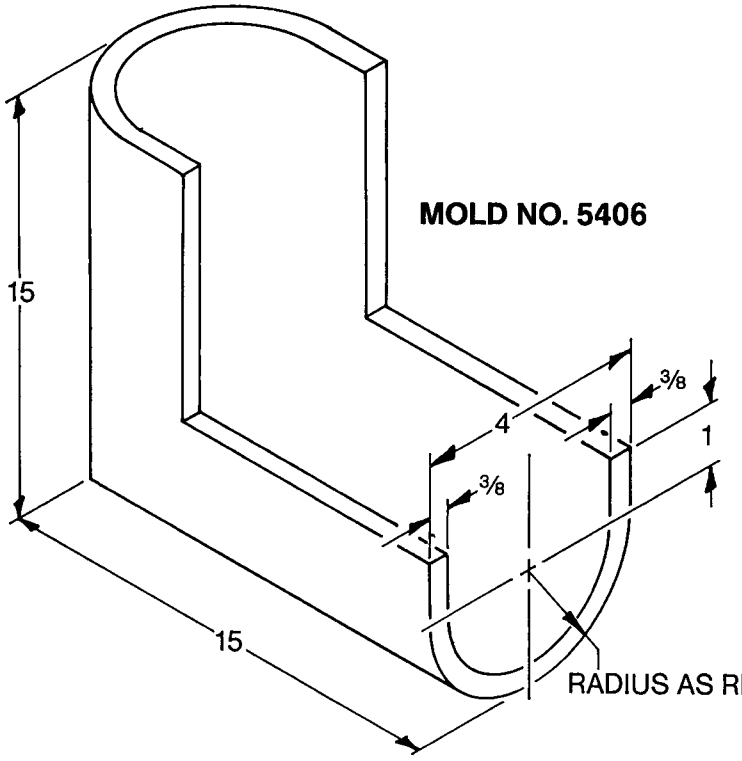
SECTION A-A



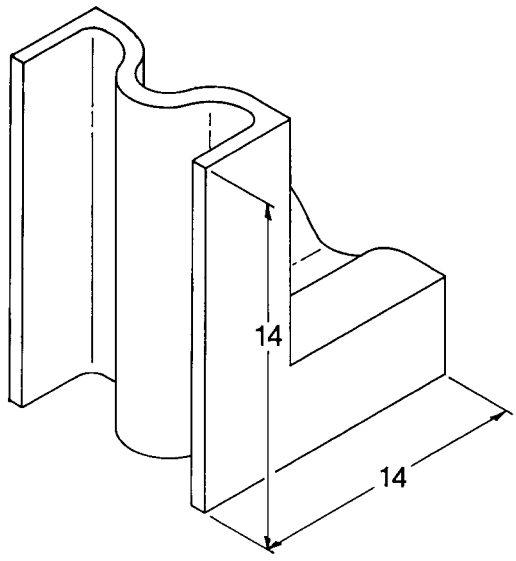
SECTION A-A



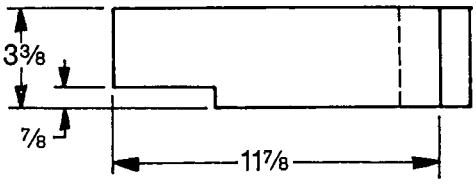
MOLD NO. 6301

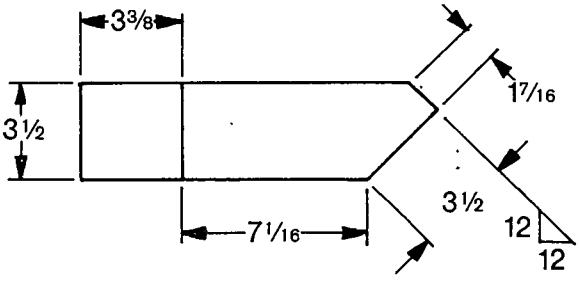


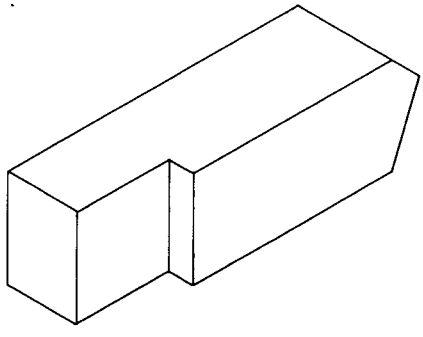
MOLD NO. 5406



CORNER MOLD NO. 5697
TYPICAL CROSS SECTION,
SEE PAGE J-4 MOLD NO. 5695

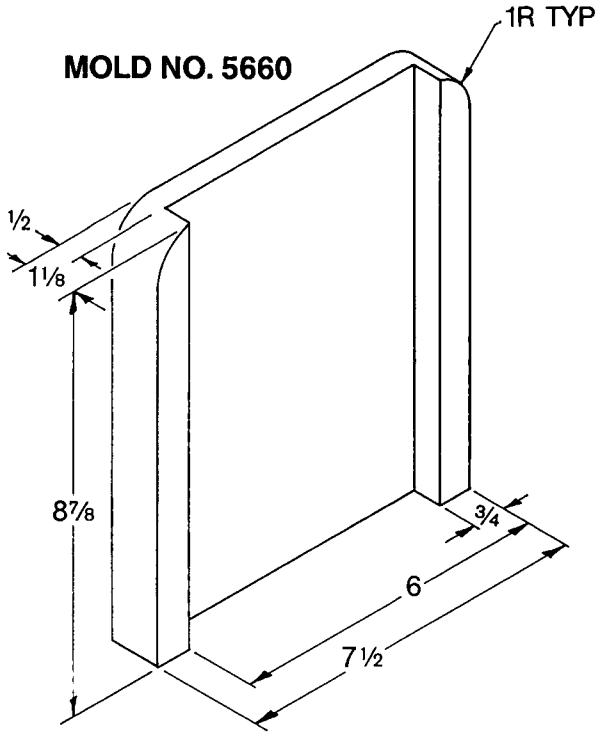




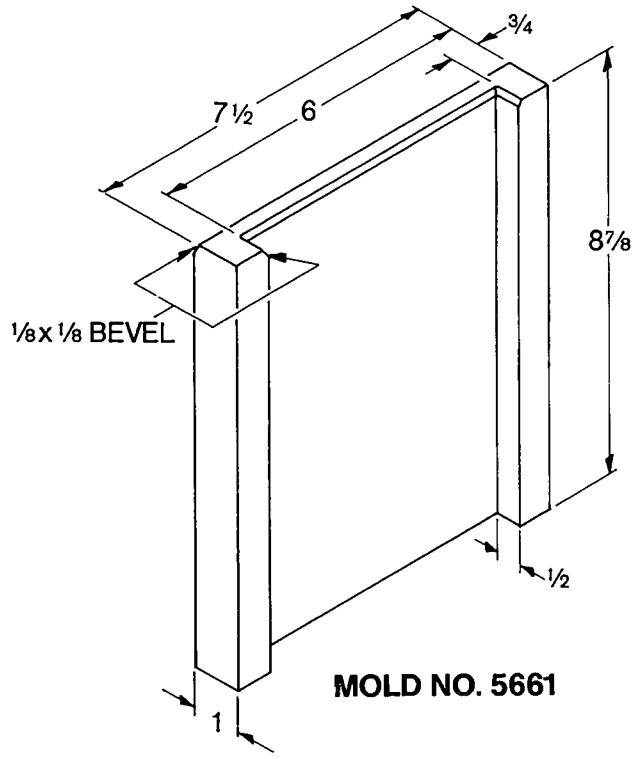


END BLOCK
MOLD NO. 3763

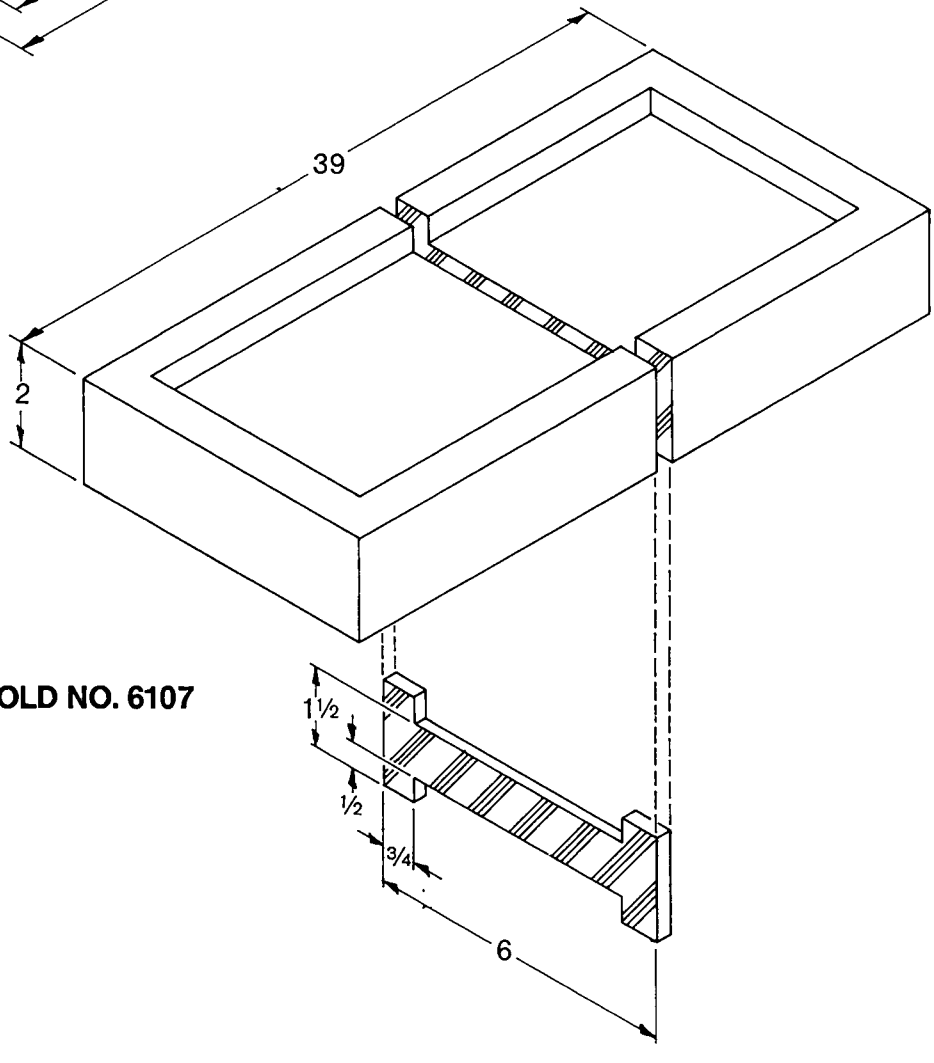
J-10



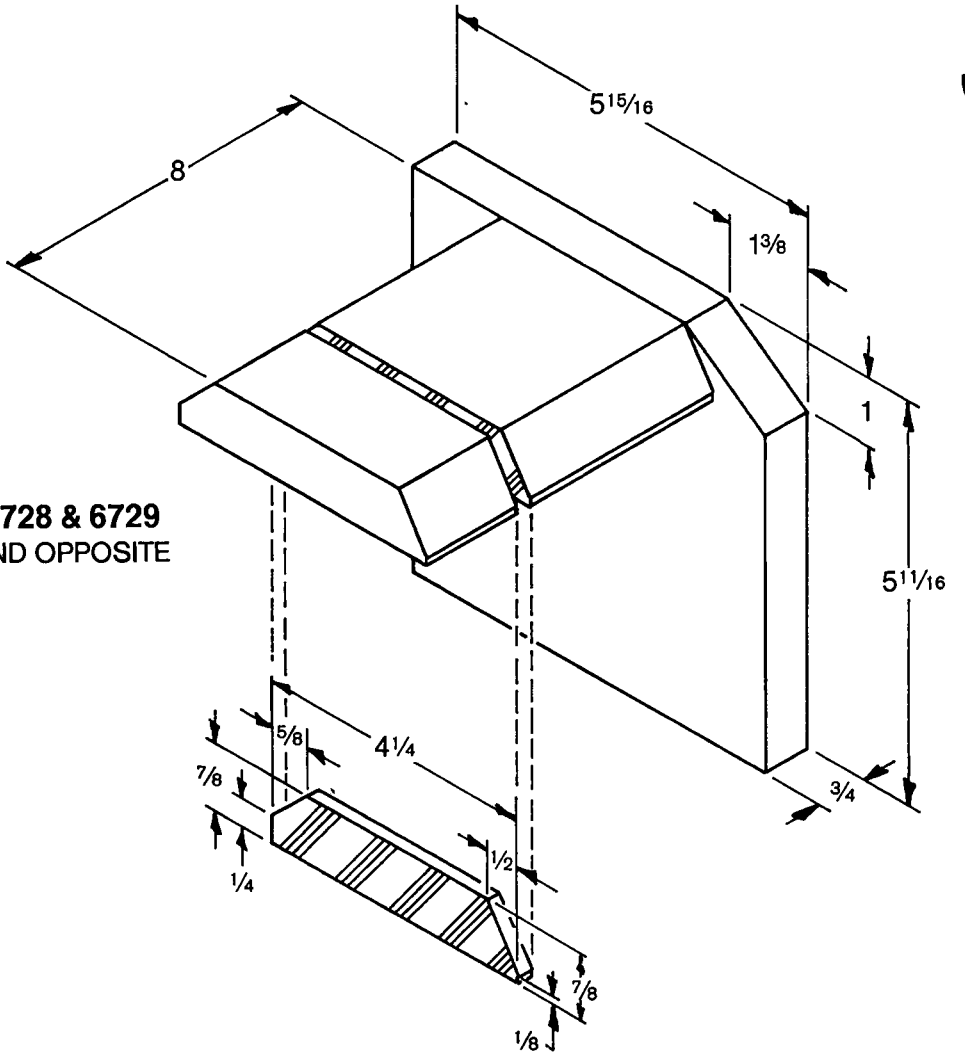
MOLD NO. 5660



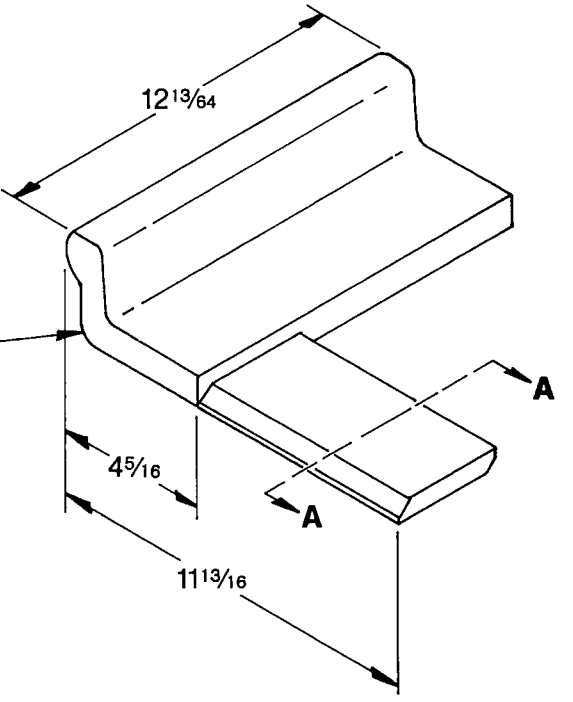
MOLD NO. 5661



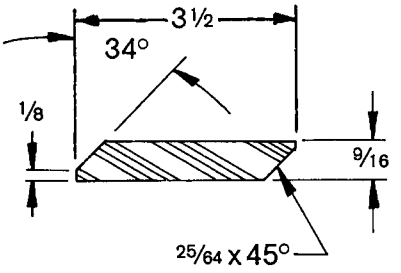
MOLD NO. 6107



MOLD NO. 6728 & 6729
AS SHOWN AND OPPOSITE



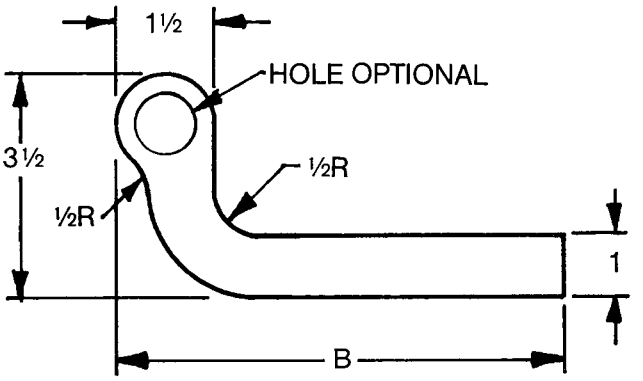
TYPICAL CROSS SECTION
PG. J 1, MOLD NO. 3545



SECTION A-A

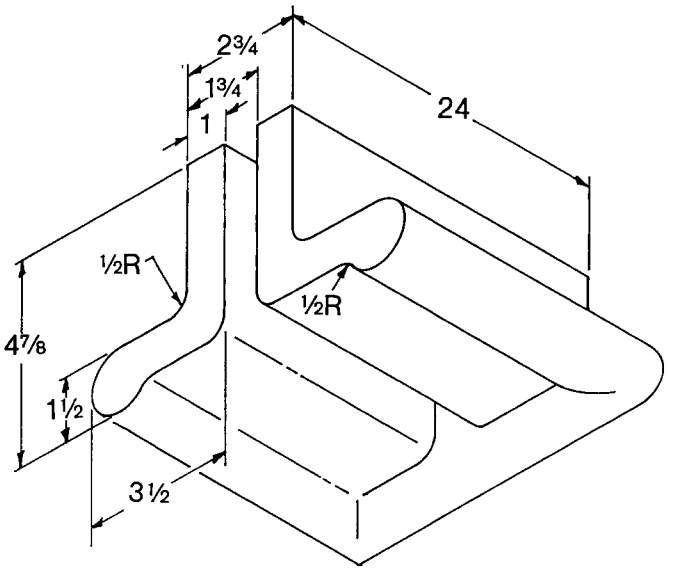
MOLD NO. 7044
AS SHOWN AND OPPOSITE

J-12



STRIP MOLD NO. 3493

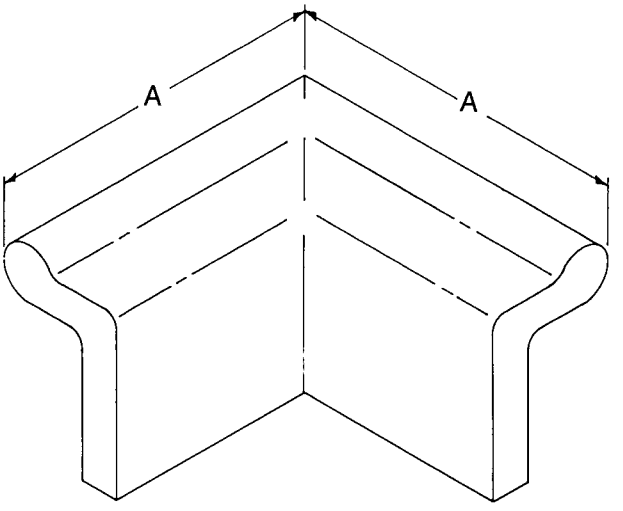
TYPICAL BULB CROSS SECTION
FOR ALL MOLDS ON THIS PAGE



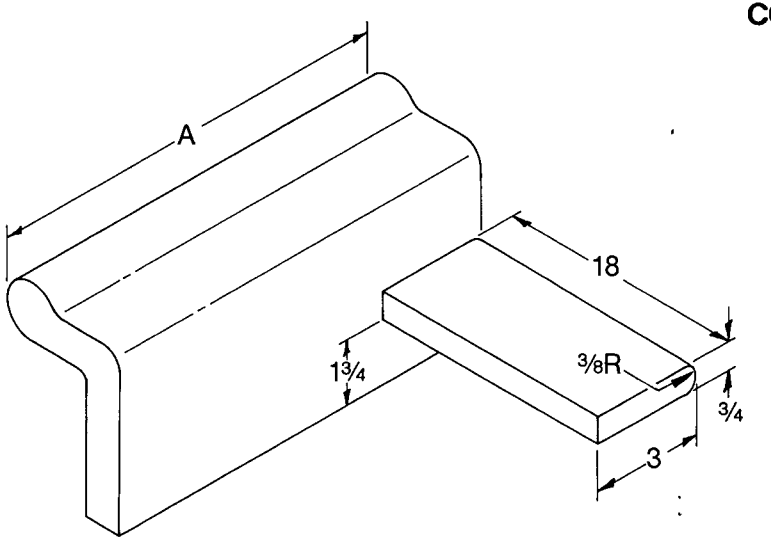
MOLD NO. 3684

MOLD NO.	A	B
3493	–	7**
5757	***	4¾
6149	19½	5⅜
5755 & 5756	19¾	4¾

***AS REQUIRED **MAX.



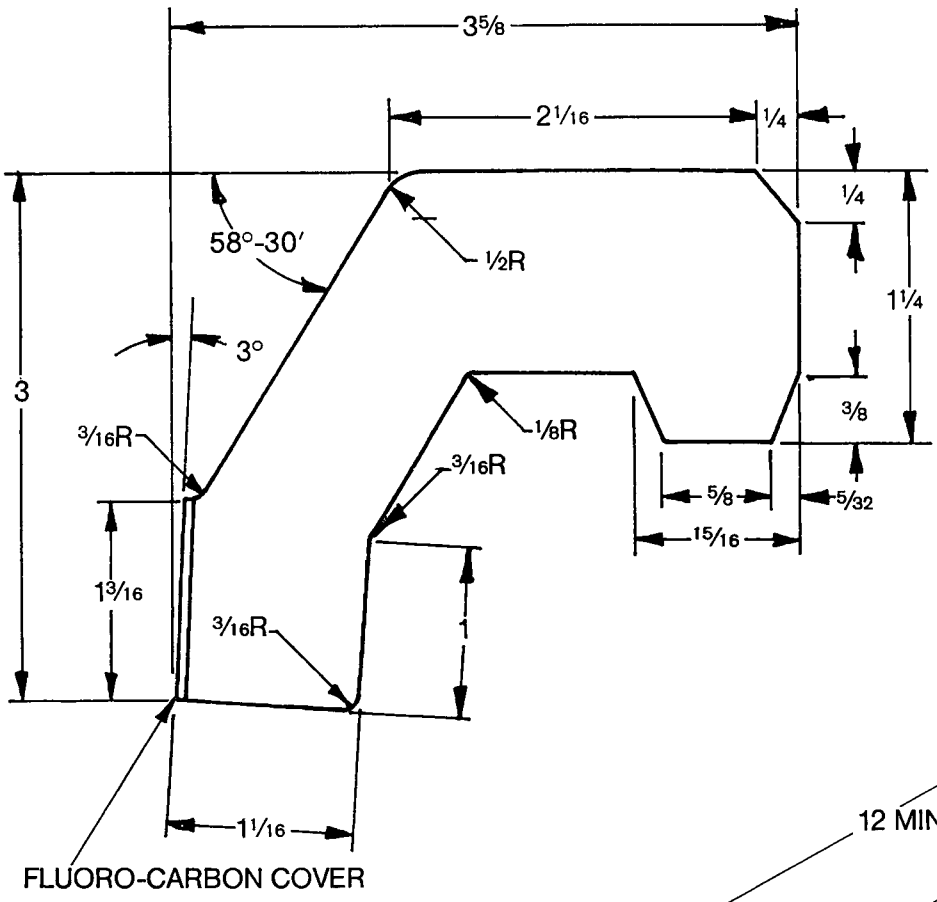
CORNER MOLD NO. 5757
CORNER MOLD NO. 6149



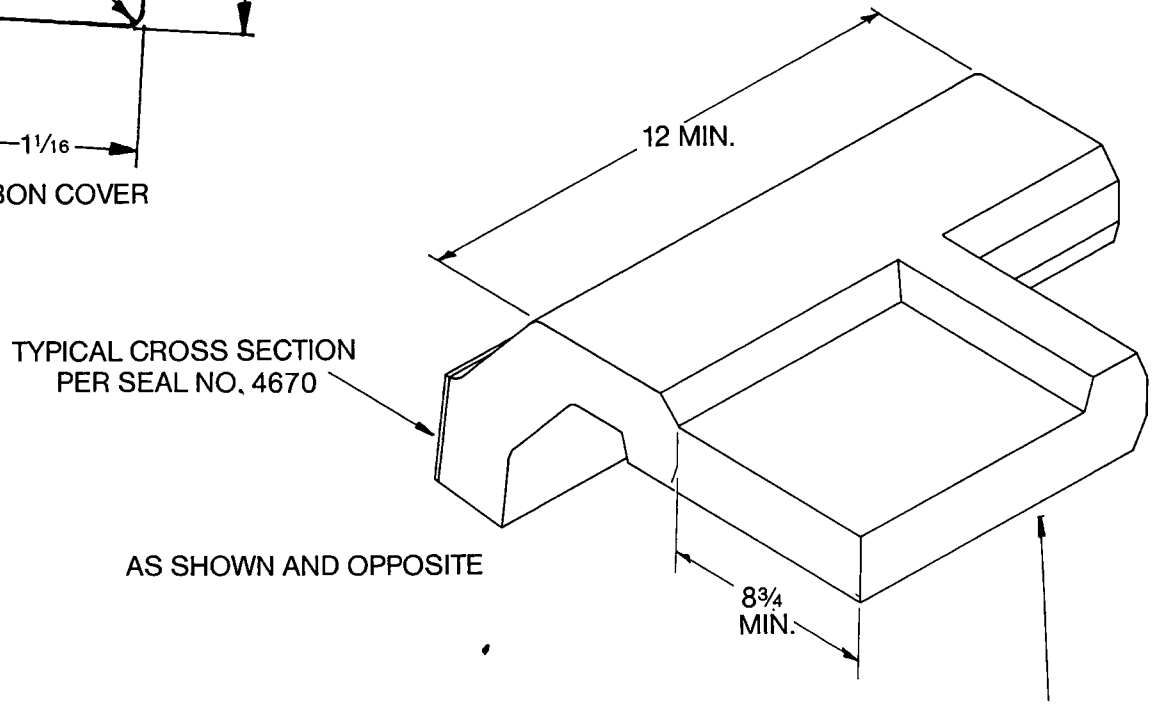
CORNER MOLD NO. 5755 & 5756

SEE CHART ABOVE

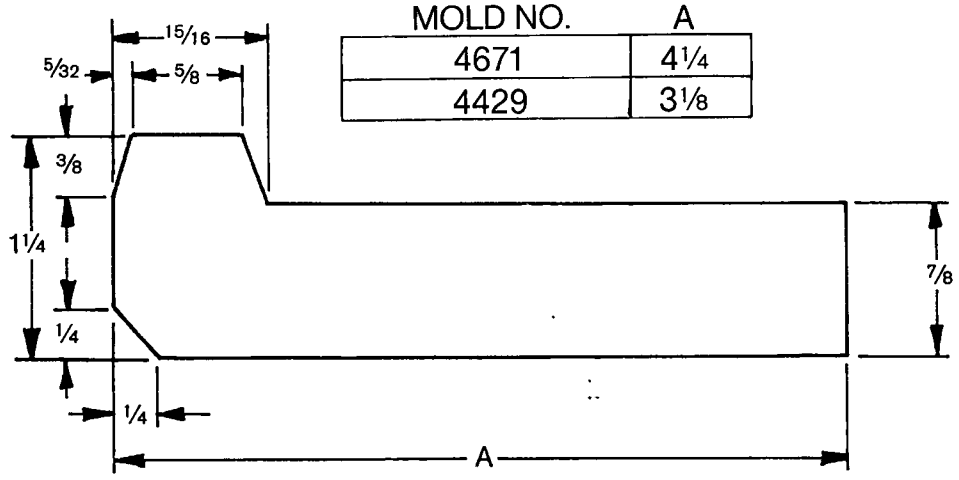
J-13



MOLD NO. 4670
SIDE SEAL FOR RADIAL GATE



MOLD NO.	A
4671	4 1/4
4429	3 1/8

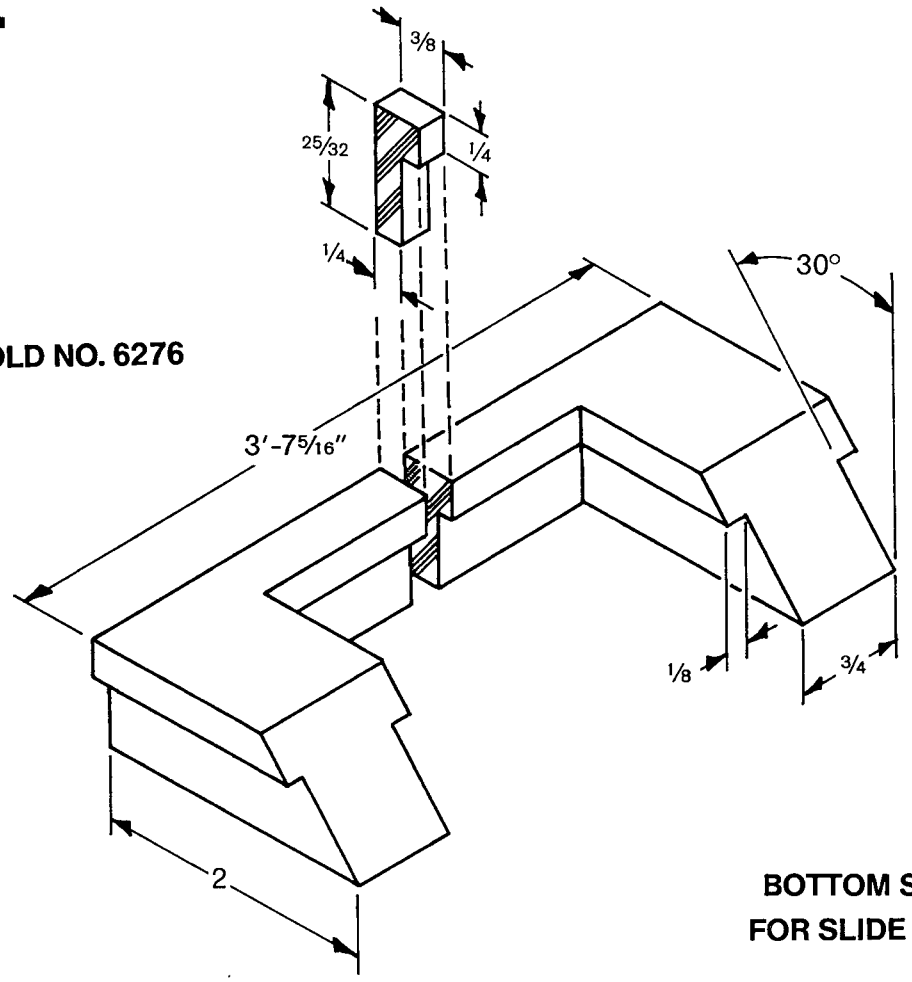


BOTTOM SEAL

MOLD NO. 4671
MOLD NO. 4429

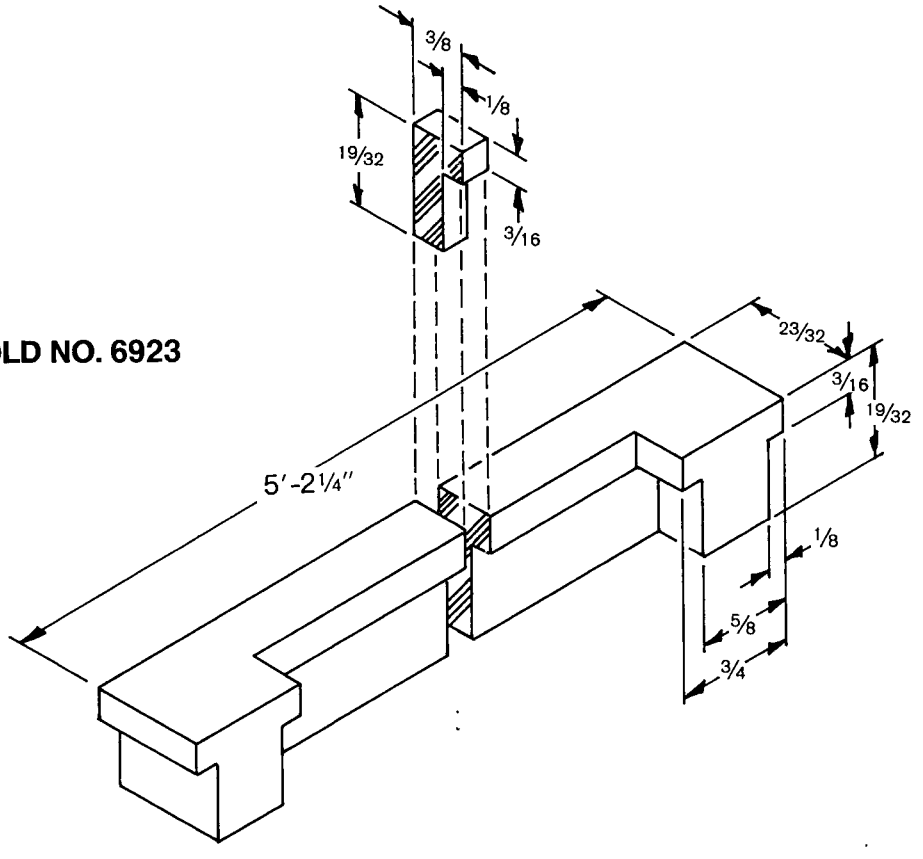
SEE CHART ABOVE

J-14



MOLD NO. 6276

BOTTOM SEALS FOR SLIDE GATES



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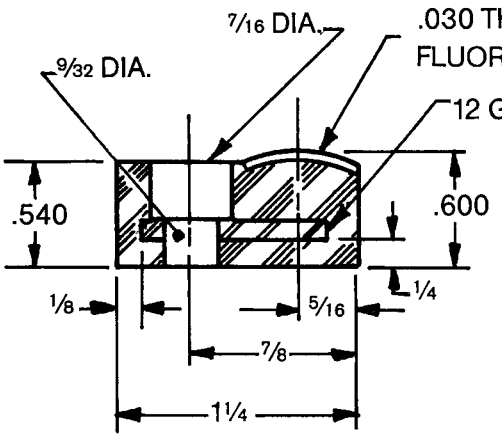
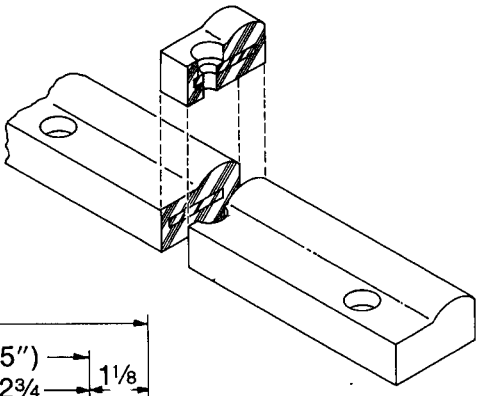
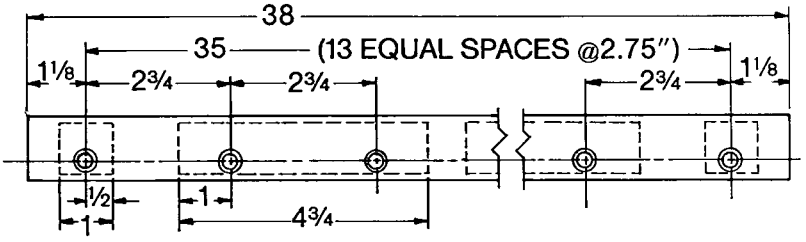
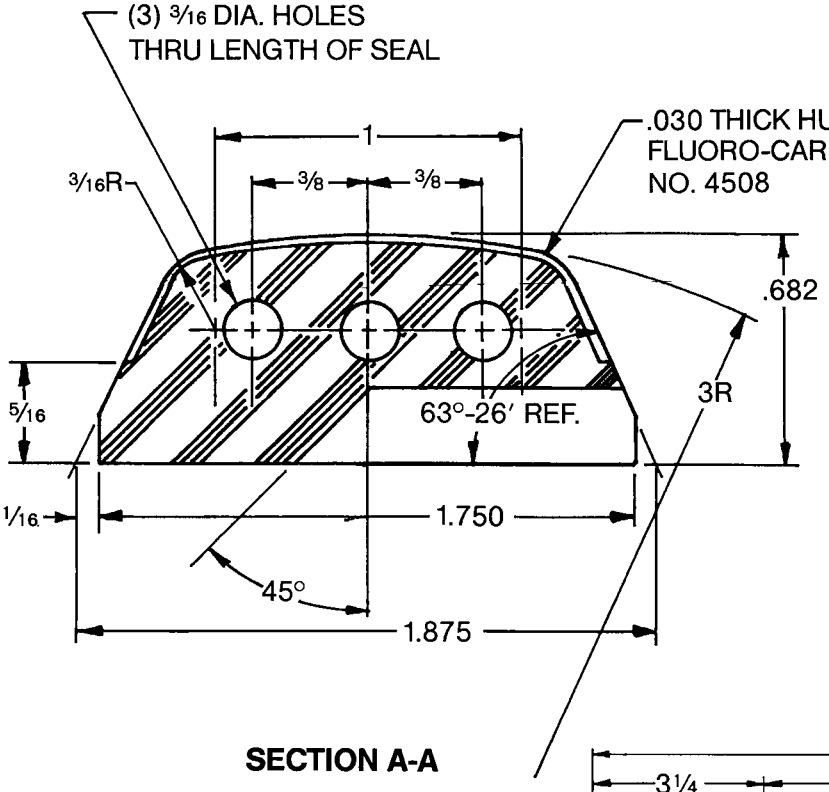


WICKET GATE SEAL
MOLD NO. 4875

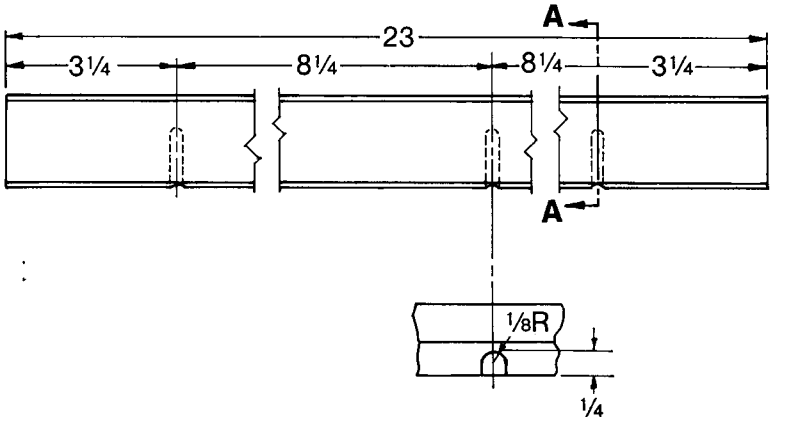




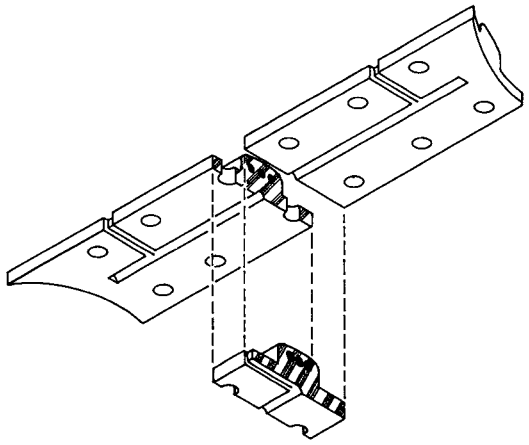


WICKET GATE SEAL
MOLD NO. 4712

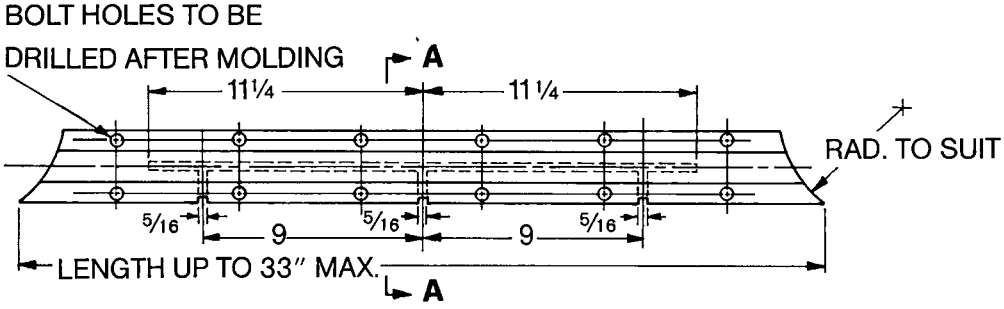
SECTION A-A

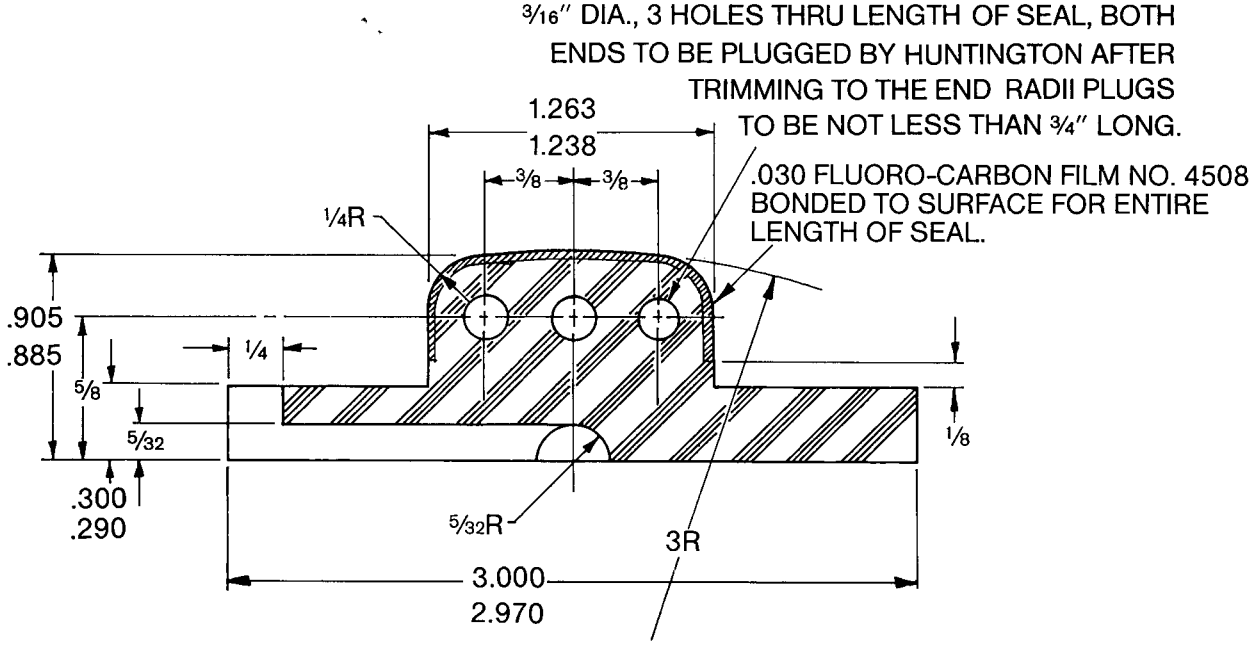


J-16



MOLD NO. 5149





SECTION A-A

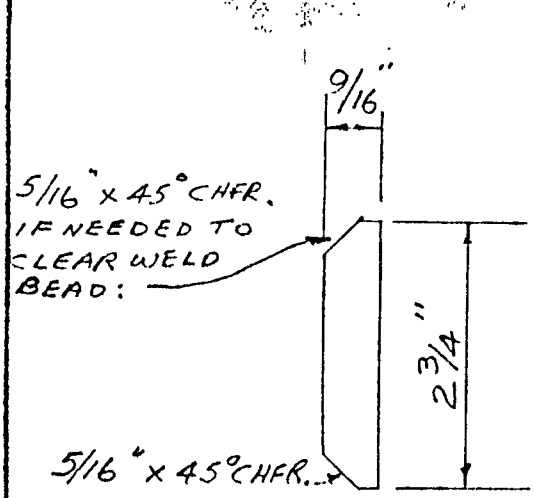
68-MNL-132

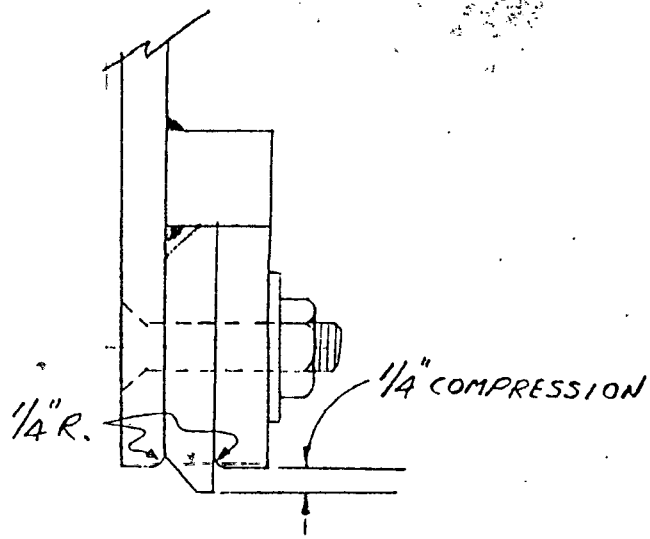
TYPICAL BOTTOM WEDGE SEALS

This illustrates a popular bottom seal and its installation.

This type of seal is used on vertical lift and similar gates. It should not be used where it makes a sliding contact with the seal seat because of the high friction load resulting from the substantial compression needed for effective sealing.

The chamfer at the bottom is (1) to reduce the seal's contact area for ready compression and (2) to provide space for the displacement of rubber during compression. The skin plate and the clamp bar should be radiused to avoid laceration and surface damage to the rubber during compression--and at the same time, add space for its





displacement during compression.

A chamfer is provided at the top only if it is needed to clear a weld bead at the lower edge of the top stop bar.

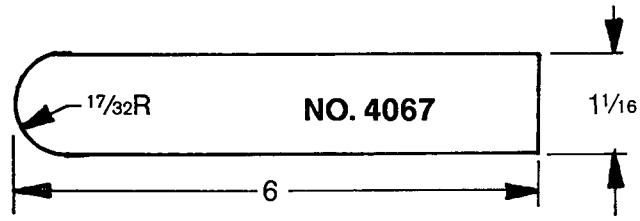
If so installed--though the seal will take a permanent set--it will operate successfully for many years because of the high initial compression loading. They should be made of the same high grade material from which J seals are made--as exemplified by the Typical Rubber Specifications appearing on page 8 of Huntington catalog No. 105, "Rubber Gate Seals for Hydraulic Structures".

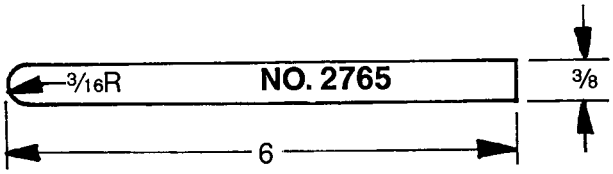
There are many modifications of this basic design, such as special angles, radiused edges instead of chamfers, fully radiused (bull-nosed) bottom edges, thicker and wider, etc. These different types are illustrated in Section K of Huntington catalog No. 105.

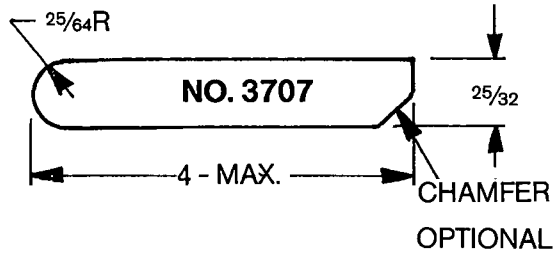
HUNTINGTON RUBBER COMPANY
DIVISION OF NEW ERA, INC.
P. O. BOX 570
PORTLAND, OREGON 97207

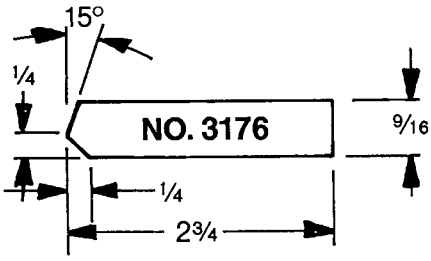
HUNTINGTON RUBBER MILLS		
7030 S. W. MACADAM AVE. PORTLAND, OREGON		
TOLERANCES: .XX = ± ; .XXX = ±		TITLE: BOTTOM WEDGE SEALS FOR LIFT GATES
SCALE: AS SHOWN	DATE	
DES. P.E.H.	4/30/68	
DWN.		DWG. NO. 68-MNL-132 REV.
APP.		

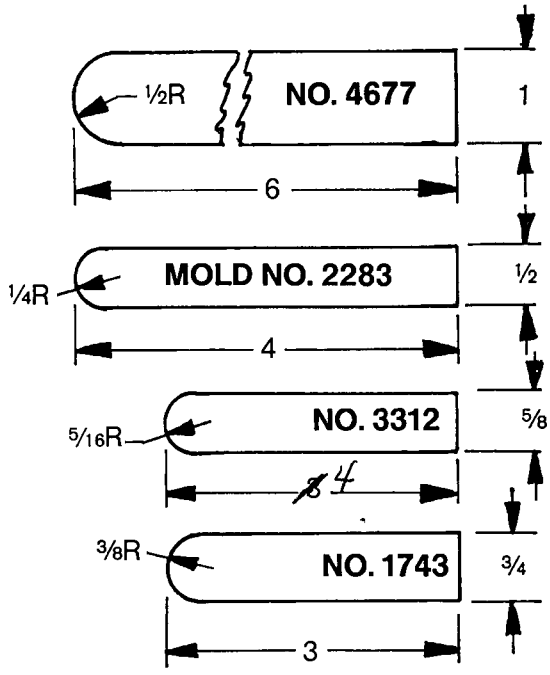
K-1

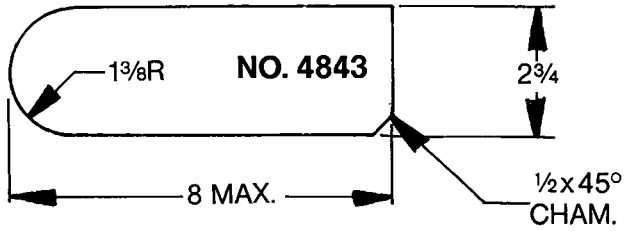

17/32R
NO. 4067
1 1/16
6

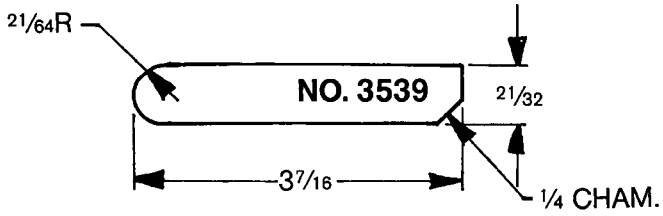

3/16R
NO. 2765
3/8
6

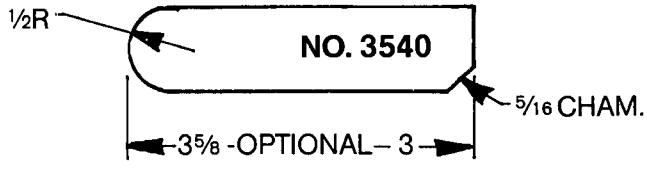

25/64R
NO. 3707
25/32
4 - MAX.
CHAMFER
OPTIONAL

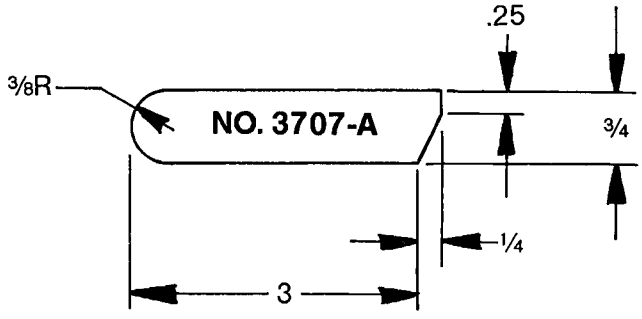

15°
1/4
NO. 3176
9/16
1/4
2 3/4

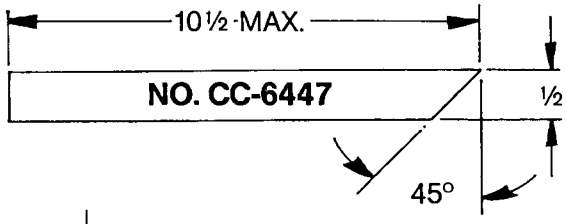

1/2R
NO. 4677
1
6
1/4R
MOLD NO. 2283
1/2
4
5/16R
NO. 3312
5/8
3/8R
NO. 1743
3/4
3

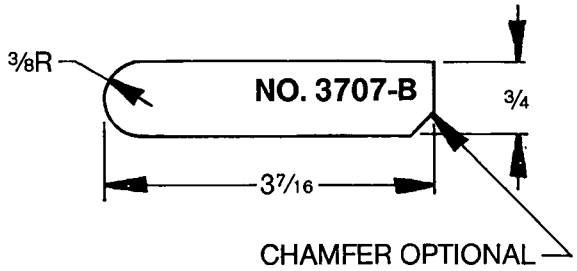

1 3/8R
NO. 4843
2 3/4
8 MAX.
1/2x45°
CHAM.

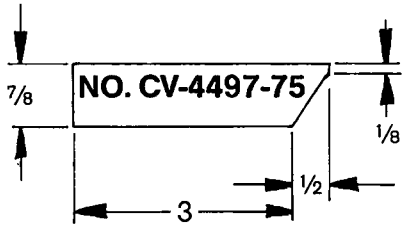

21/64R
NO. 3539
21/32
3 7/16
1/4 CHAM.


1/2R
NO. 3540
5/16 CHAM.
3 5/8 -OPTIONAL- 3

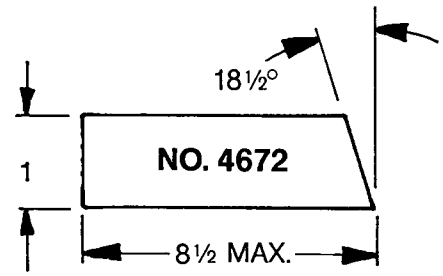

.25
3/8R
NO. 3707-A
3/4
1/4
3

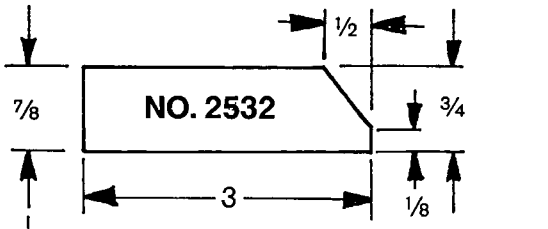

10 1/2 -MAX.
NO. CC-6447
1/2
45°

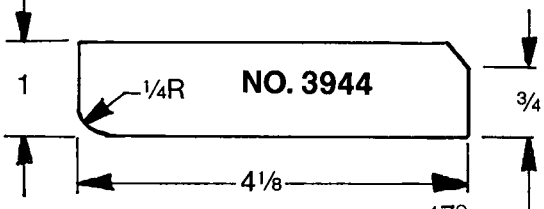

3/8R
NO. 3707-B
3/4
3 7/16
CHAMFER OPTIONAL

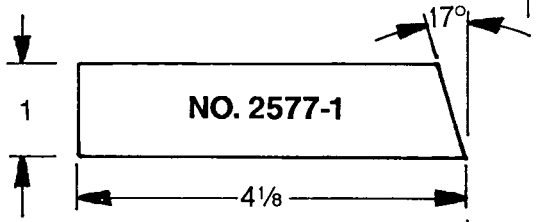

7/8
NO. CV-4497-75
1/8
1/2
3

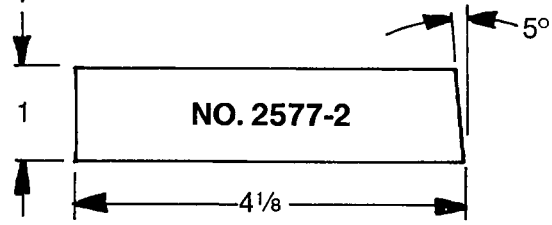
K-2

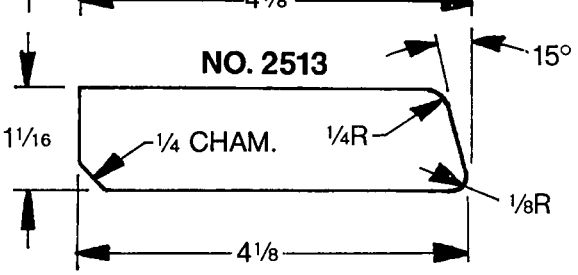


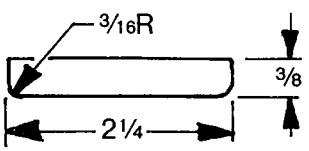












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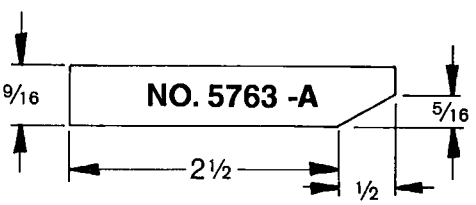

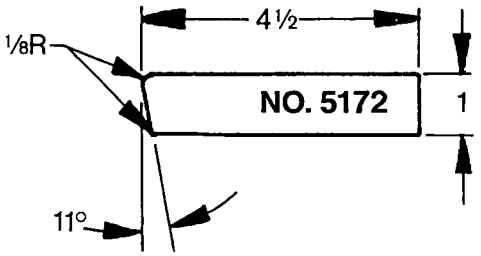

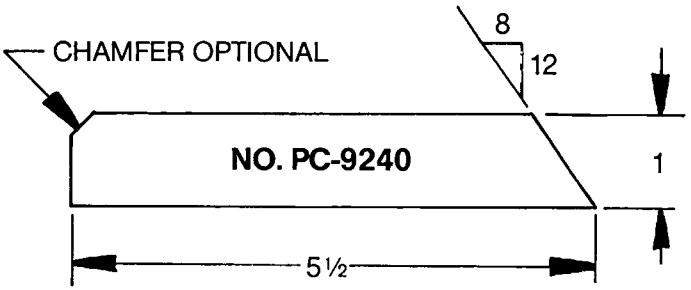

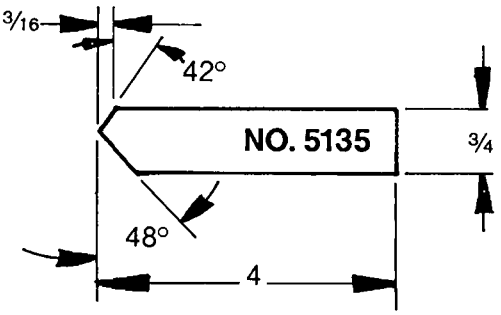

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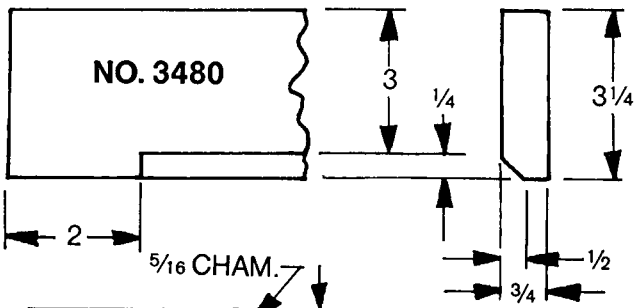
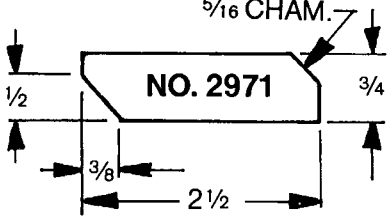
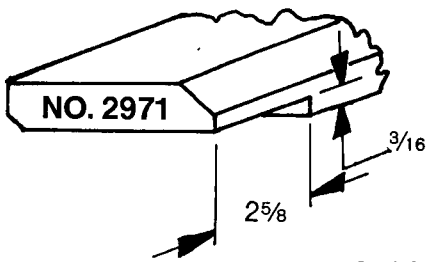


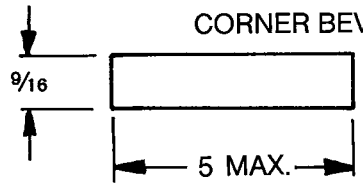




END PIECE FOR NO. 2971

K-3

CORNER BEVELS OPTIONAL



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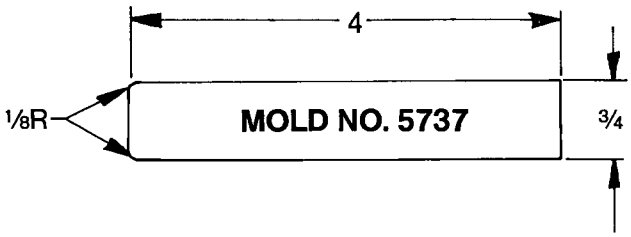
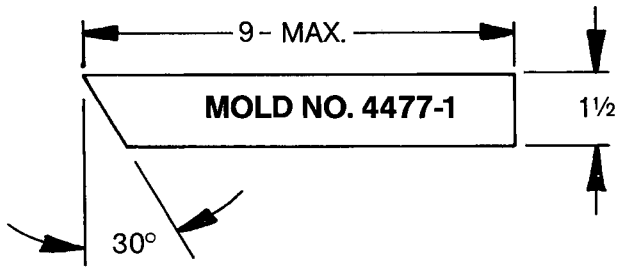
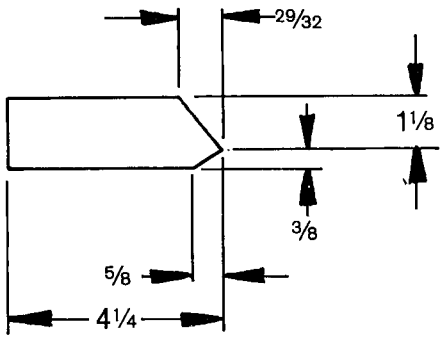
ALL MOLDS ON THIS PAGE WILL PROVIDE STRIP LENGTHS AS REQUIRED.







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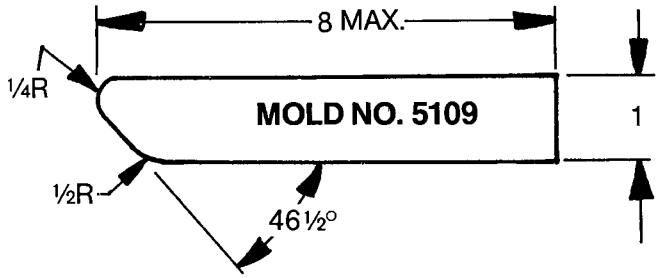
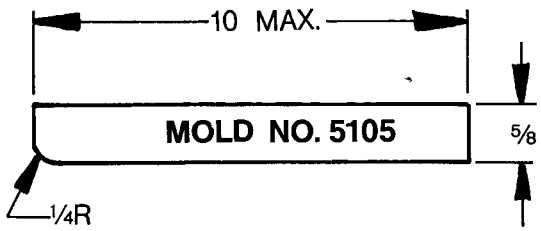
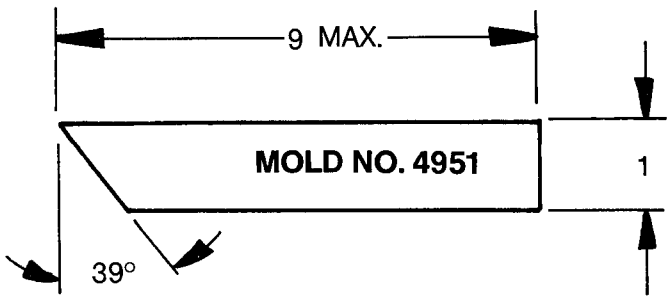
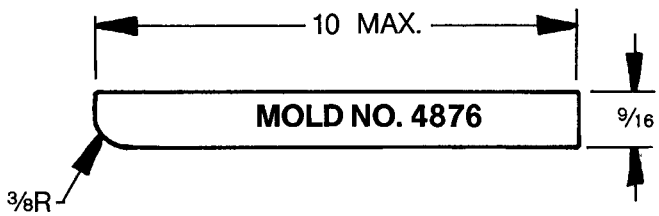
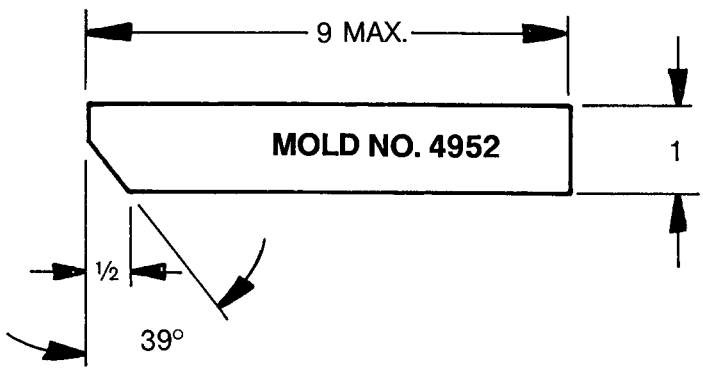
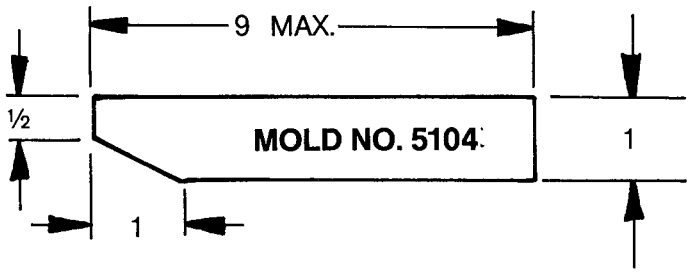




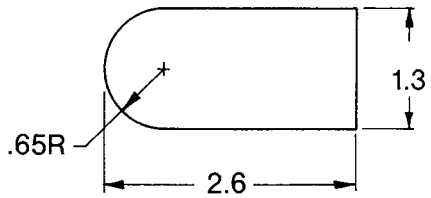




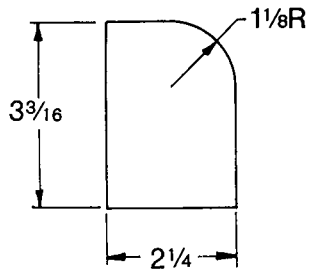




K-4

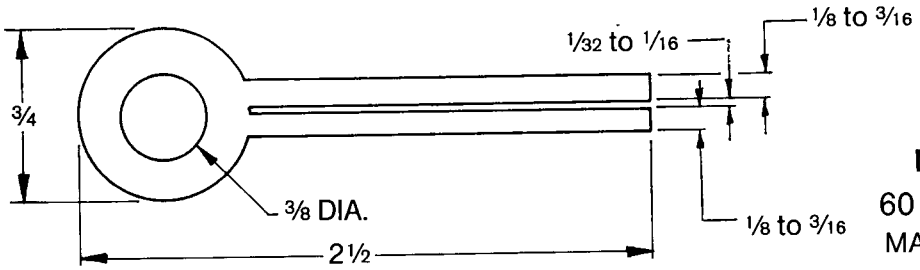


MOLD NO. 6656

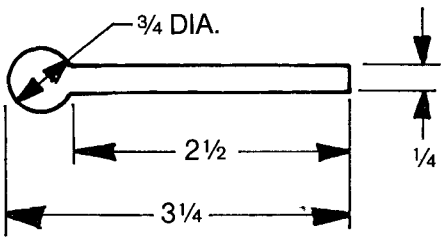


MOLD NO. 6907

ALL MOLDS ON THIS PAGE WILL PROVIDE STRIP LENGTHS AS REQUIRED, EXCEPT AS NOTED.



NO. B1-103-72
60 TO 70 DURO NATURAL RUBBER
MAX. LENGTH PER PIECE—12'



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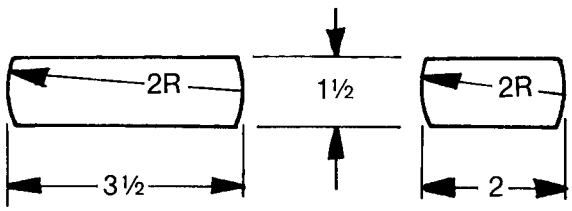

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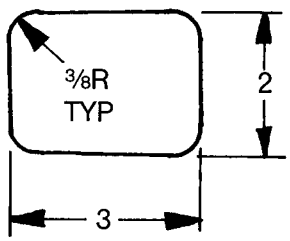

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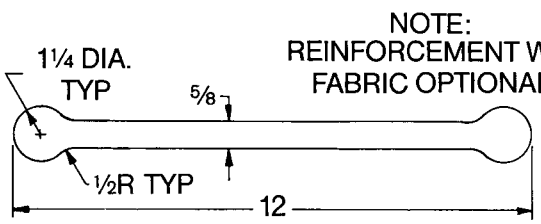

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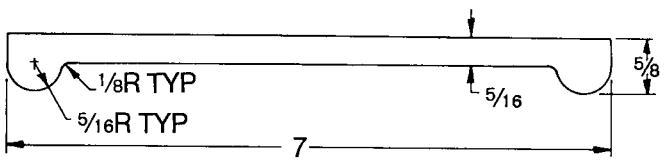

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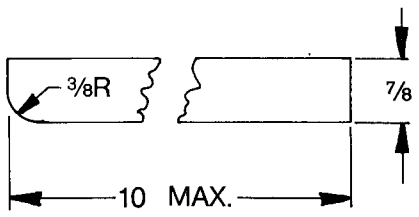
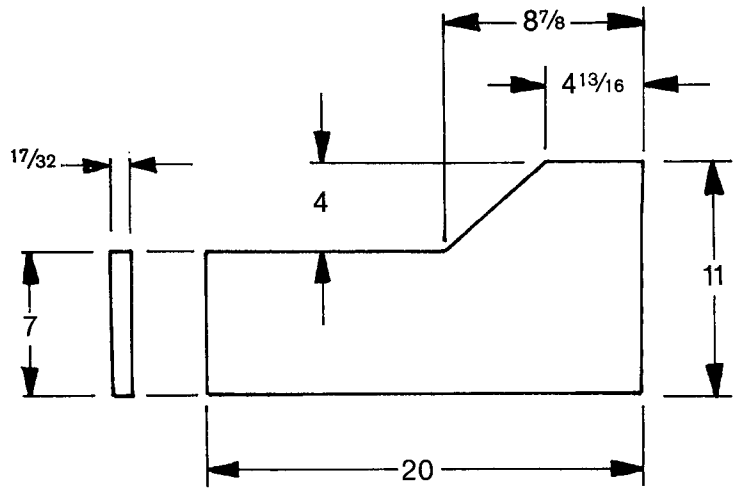
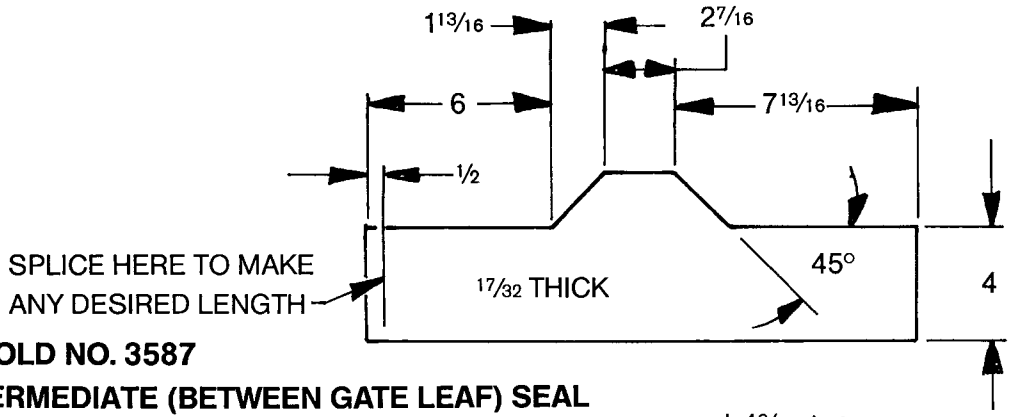


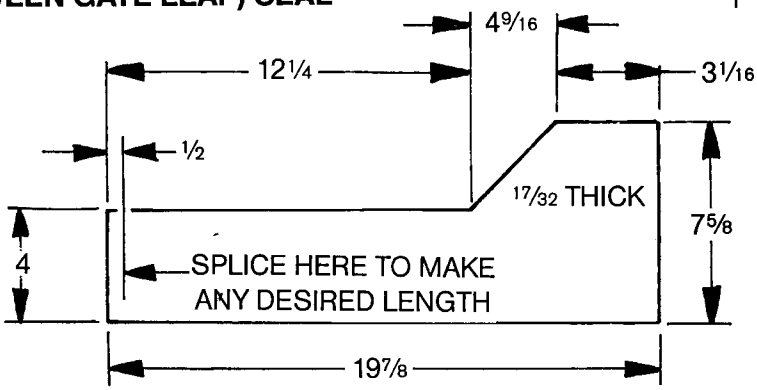
MOLD NO. 6097



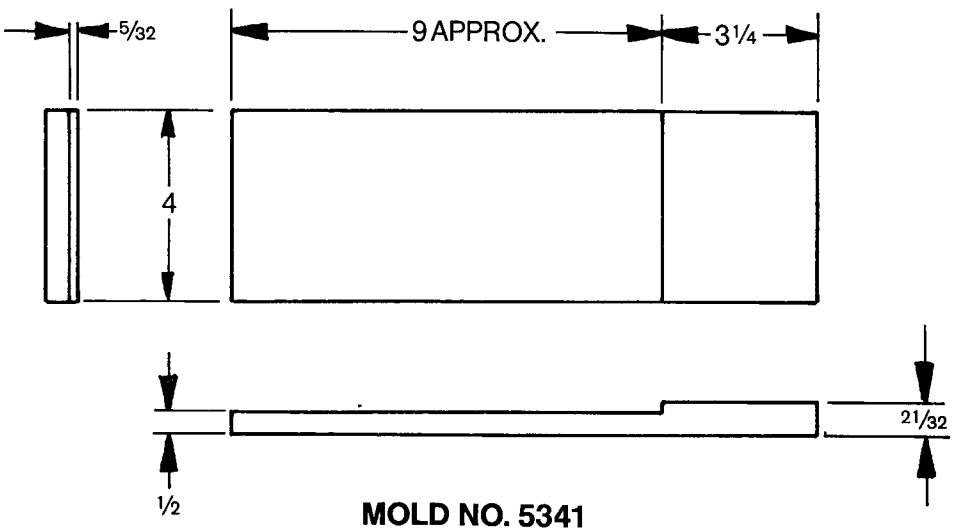
END PIECE
MOLD NO. 3708
INTERMEDIATE (BETWEEN GATE LEAF) SEAL



MOLD NO. 3587
INTERMEDIATE (BETWEEN GATE LEAF) SEAL

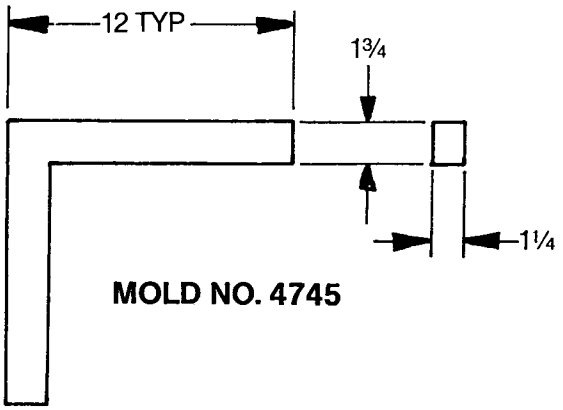


MOLD NO. 3520
INTERMEDIATE (BETWEEN GATE LEAF) SEAL



MOLD NO. 5341

K-6



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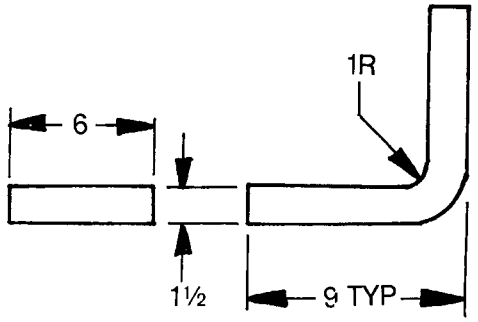
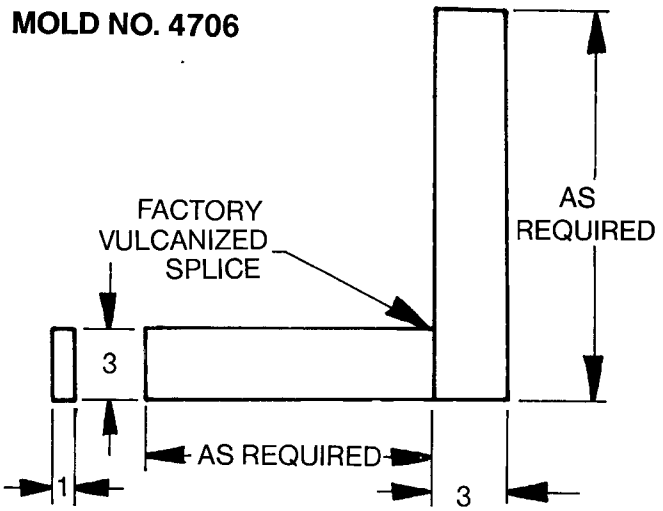
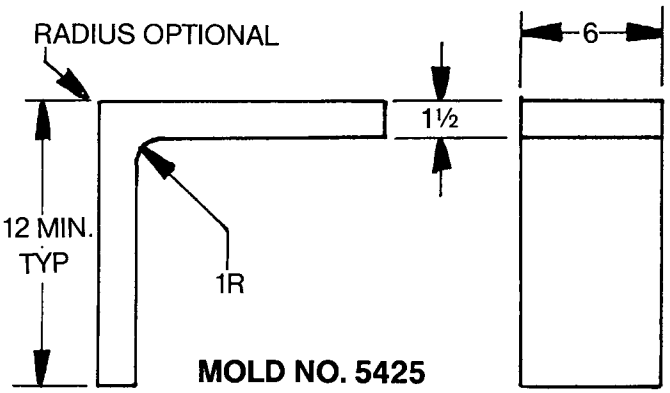


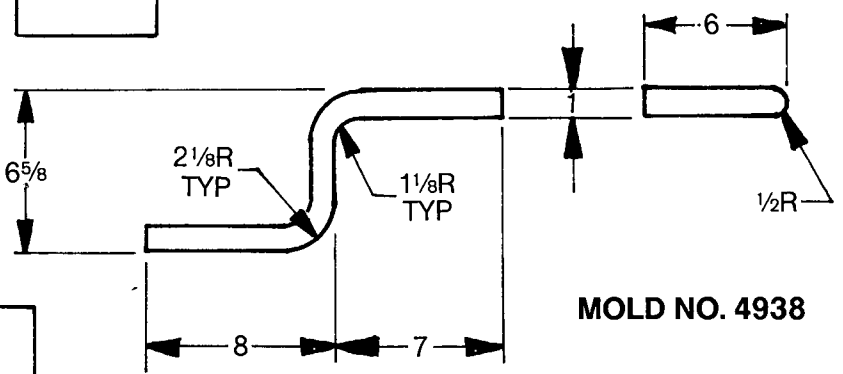
MOLD NO. 4706



MOLD NO. AB-9544



MOLD NO. 5425



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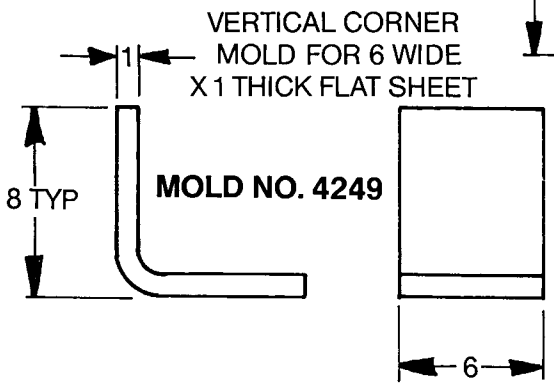
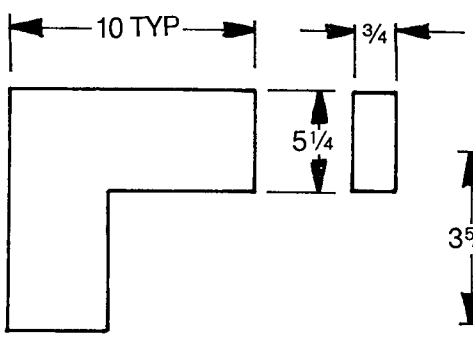


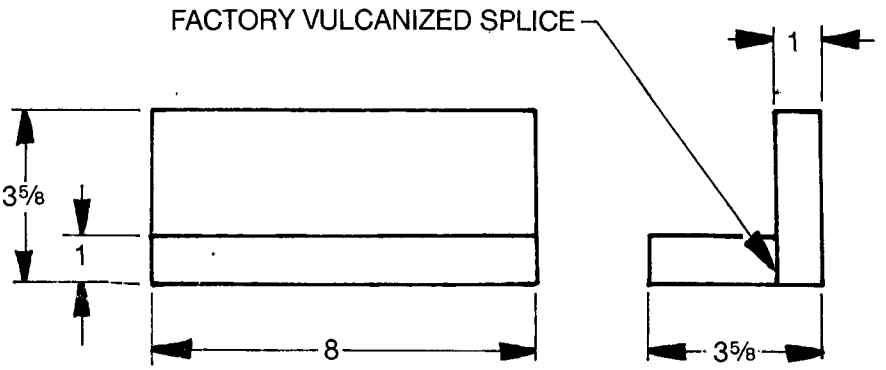
MOLD NO. 4249

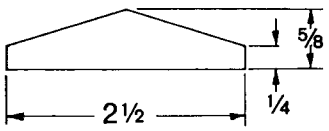


FLAT CORNER MOLD

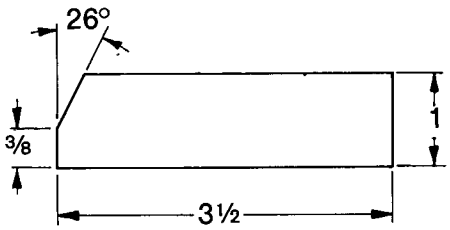
MOLD NO. 3910

MOLD NO. SR-8218

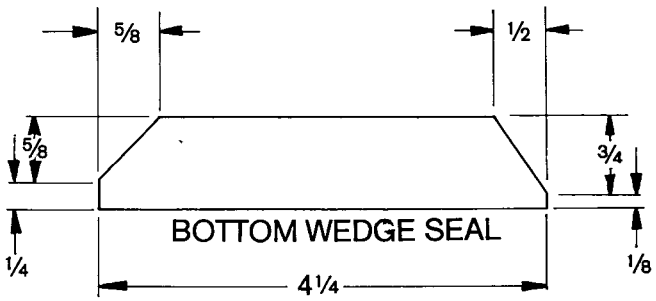




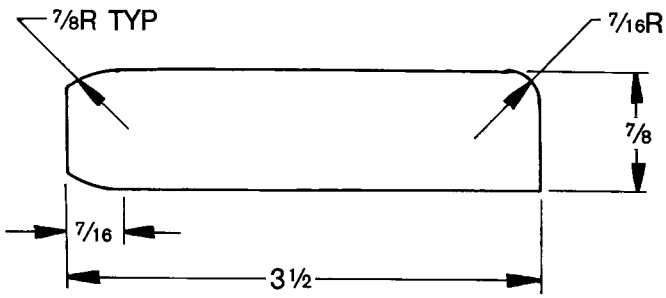
PART NO. 79A4082
EXTRUDED



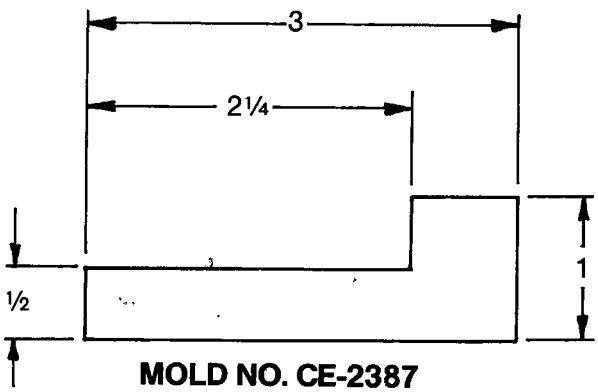
MOLD NO. 4190-A
3½" FLAT SEALING STRIP



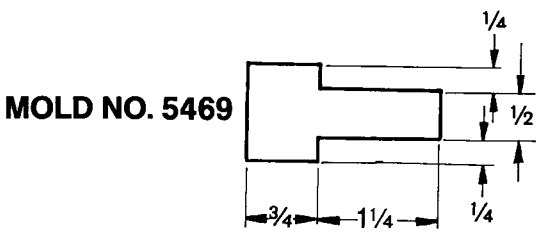
MOLD NO. 2532-A



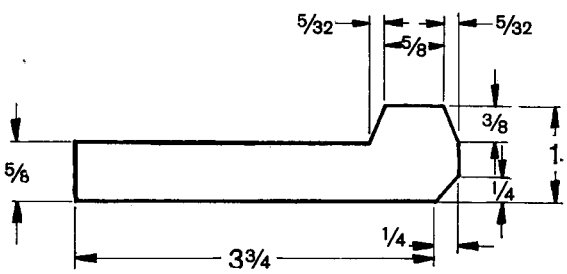
STRIP MOLD NO. 6282
BOTTOM WEDGE SEAL



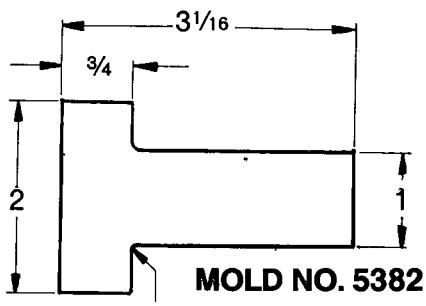
MOLD NO. CE-2387



MOLD NO. 5469

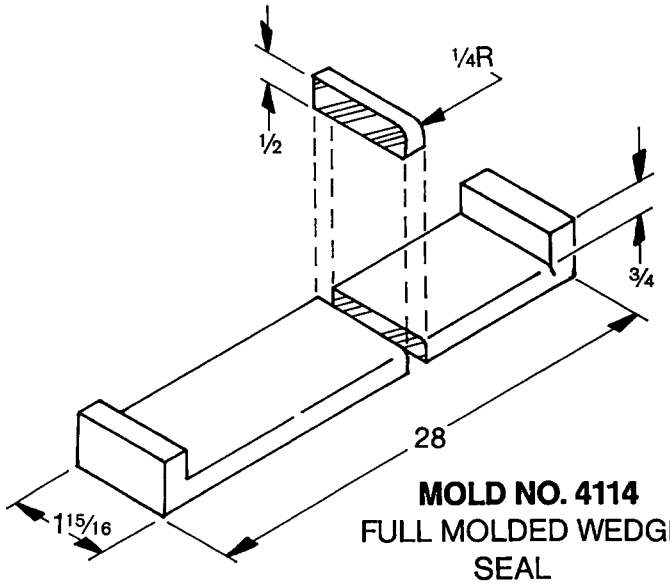


MOLD NO. 5347

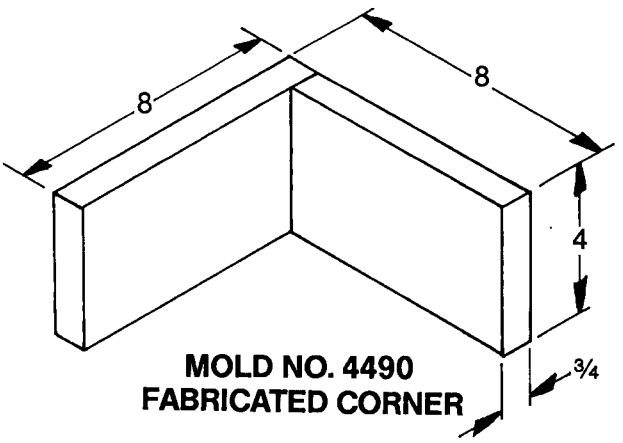


MOLD NO. 5382

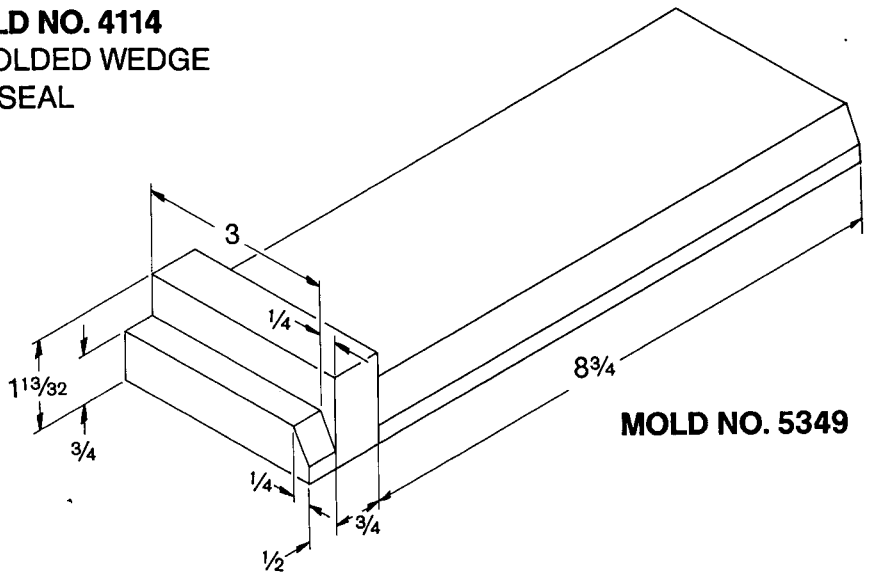
K-8



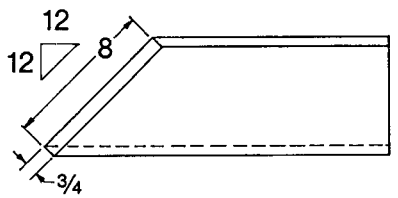
MOLD NO. 4114
FULL MOLDED WEDGE SEAL

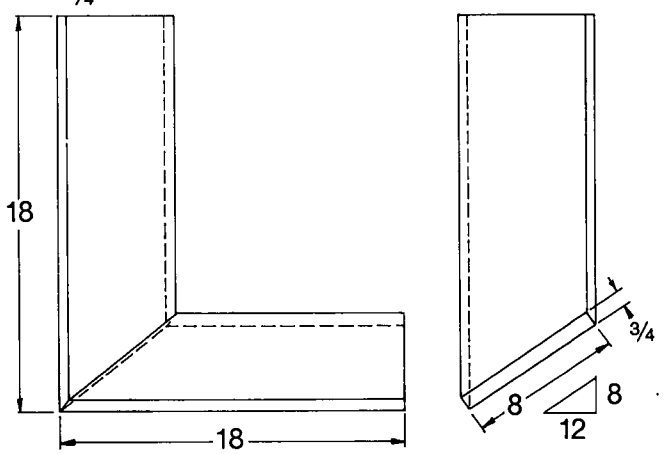


MOLD NO. 4490
FABRICATED CORNER

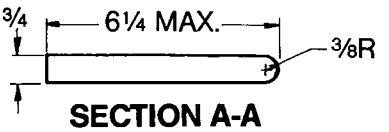


MOLD NO. 5349

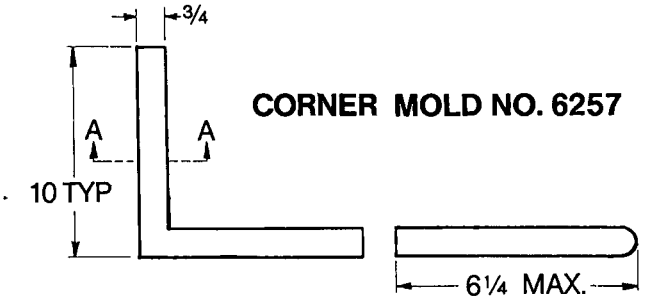




MOLD NO. 6711 & 6712
AS SHOWN AND OPPOSITE

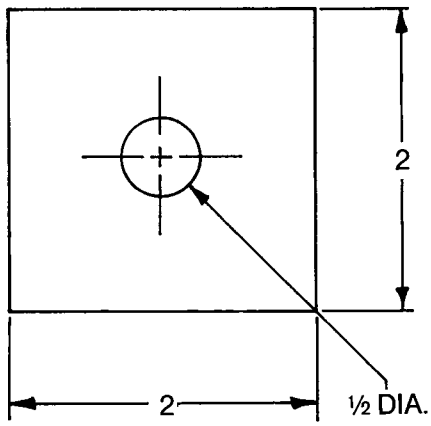


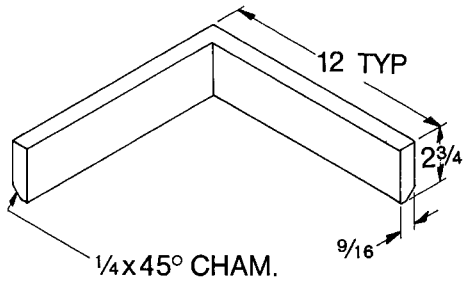
SECTION A-A
STRIP MOLD NO. 6255



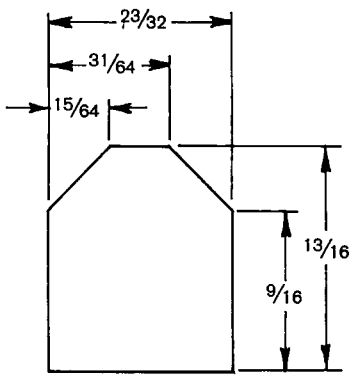
CORNER MOLD NO. 6257

MOLD NO. 5414

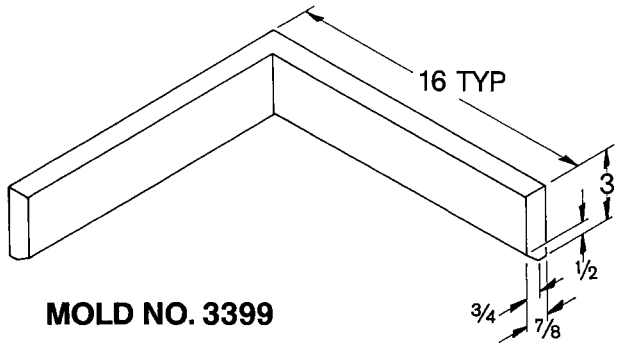




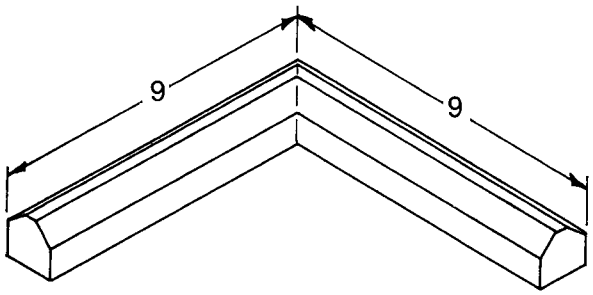
MOLD NO. 4107



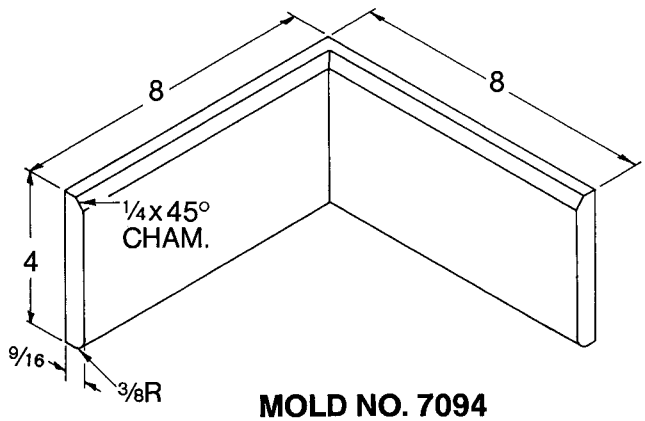
STRIP MOLD NO. 6348



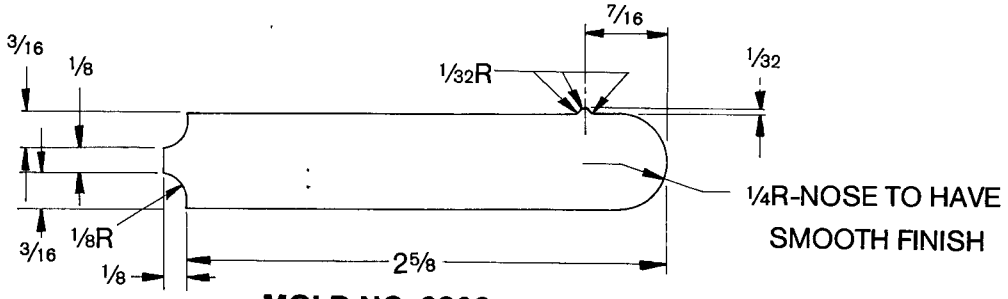
MOLD NO. 3399



CORNER MOLD NO. 6336
FOR USE WITH MOLD NO. 6348

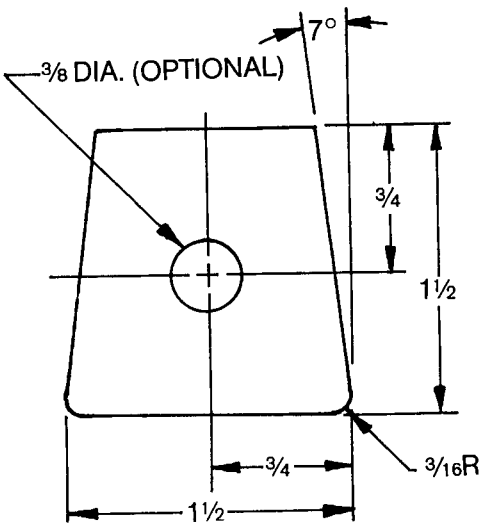


MOLD NO. 7094
FULL MOLDED BOTTOM
SEAL CORNER

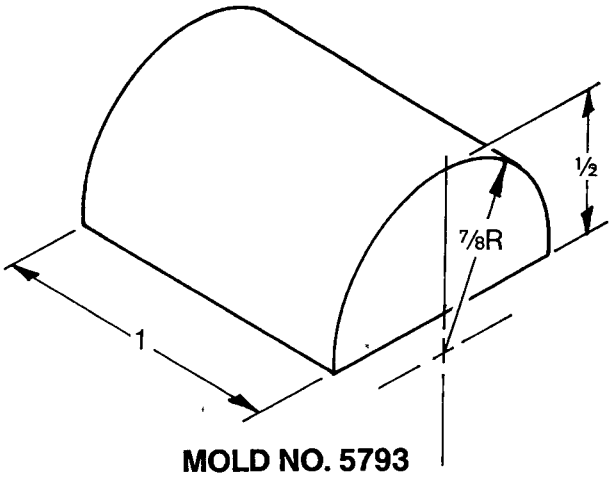


MOLD NO. 6302

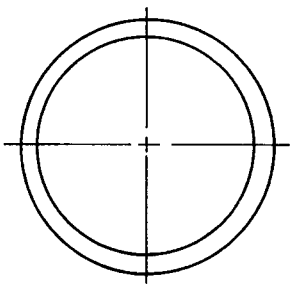
K-10



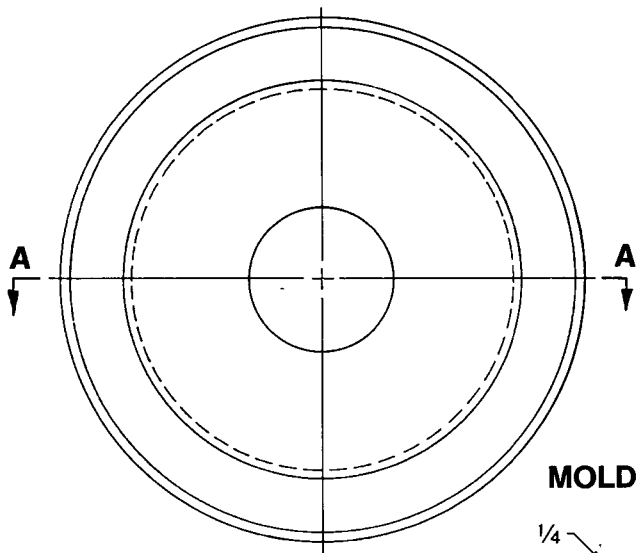
MOLD NO. 5840



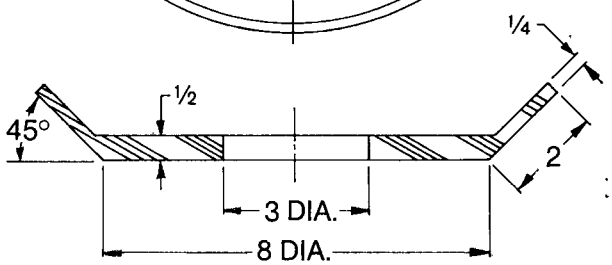
MOLD NO. 5793



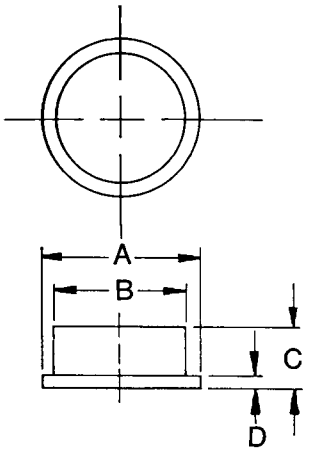
MOLD NO. 6416



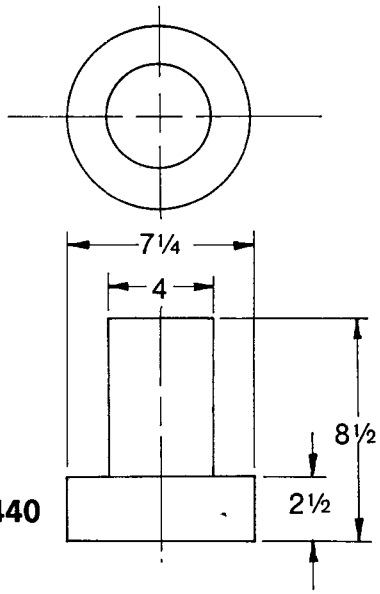
MOLD NO. 6450



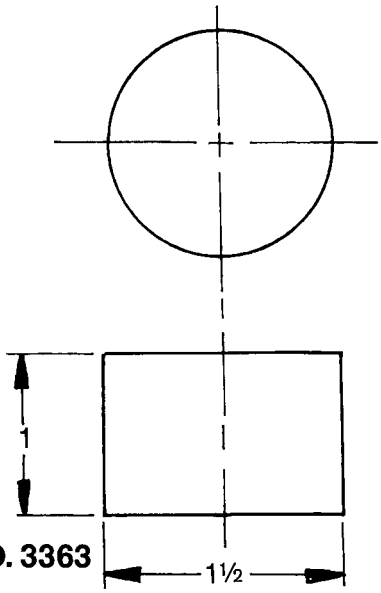
SECTION A-A



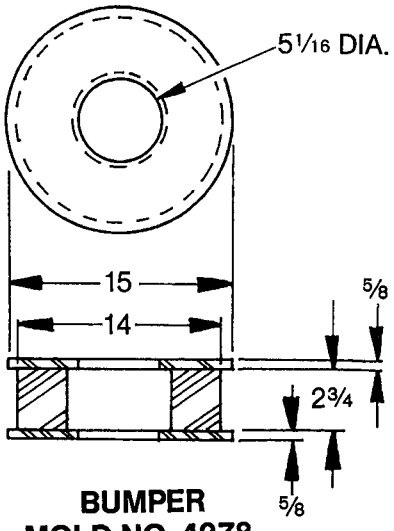
MOLD NO.	A	B	C	D
5549	12	11½	3⅝	½
5553	10	9	2¼	½



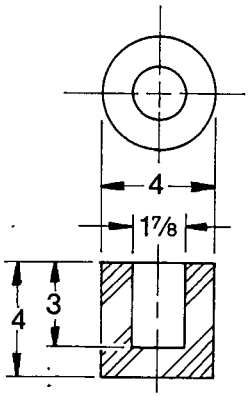
MOLD NO. 5440



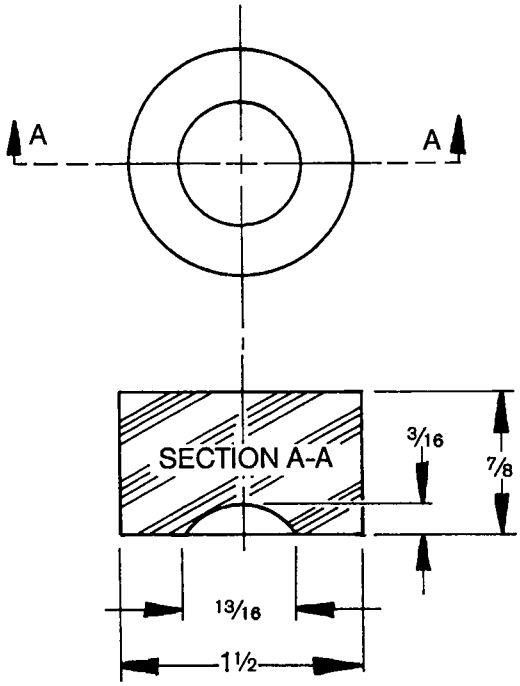
MOLD NO. 3363



BUMPER
MOLD NO. 4278



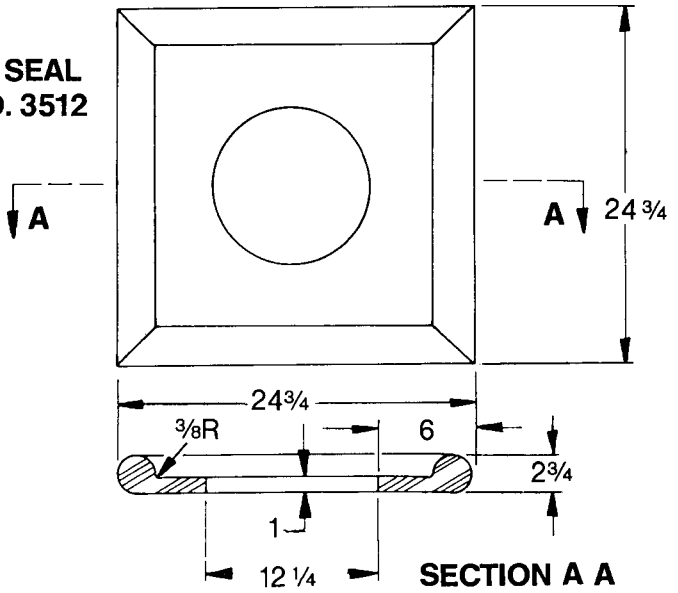
MOLD NO. 5446



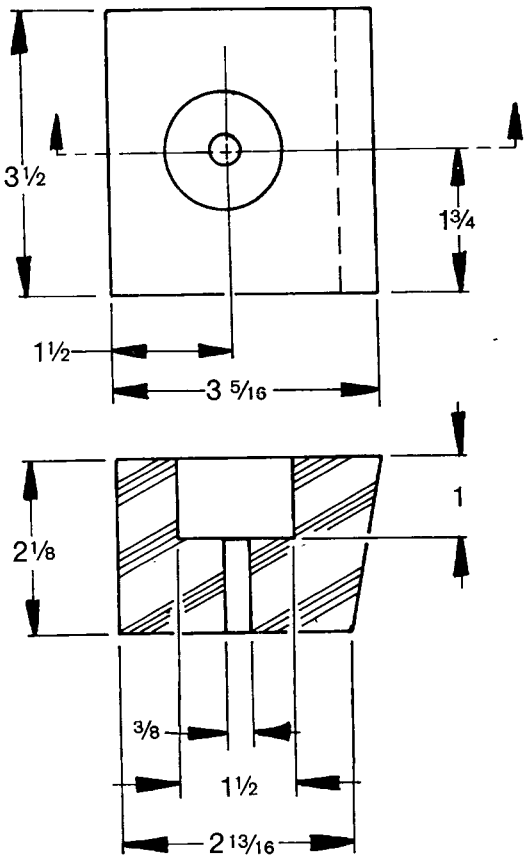
MOLD NO. 3363-1

L-2

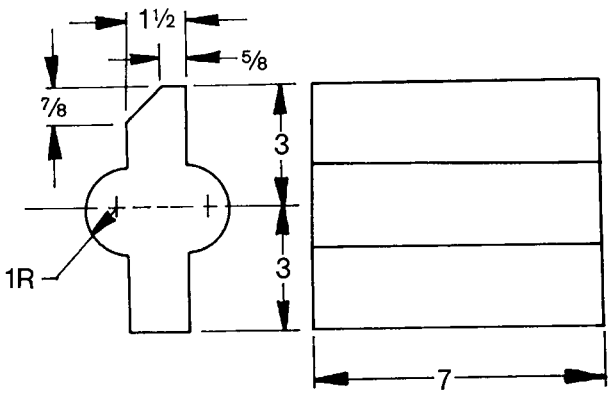
AIR PIPE SEAL
MOLD NO. 3512



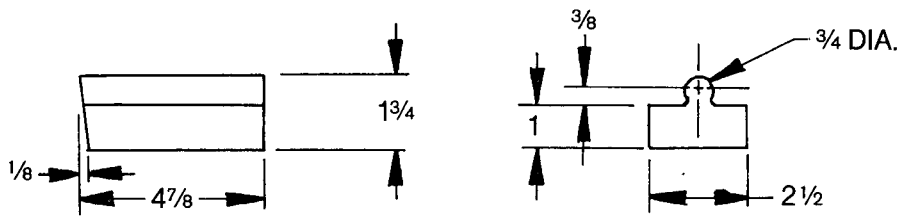
SECTION A A



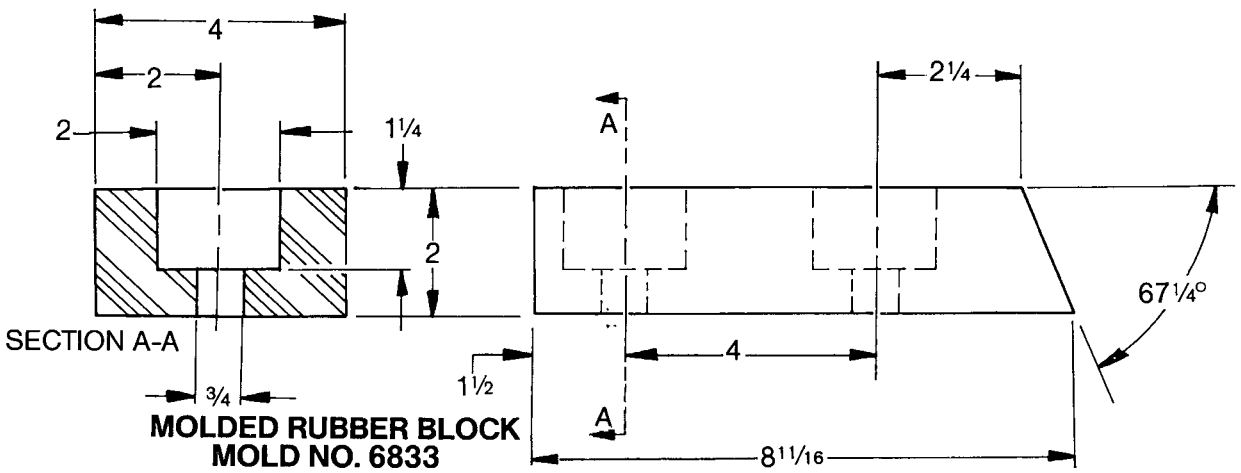
CORNER SEAL BLOCK
MOLD NO. 3369



BLOCK
MOLD NO. 4253

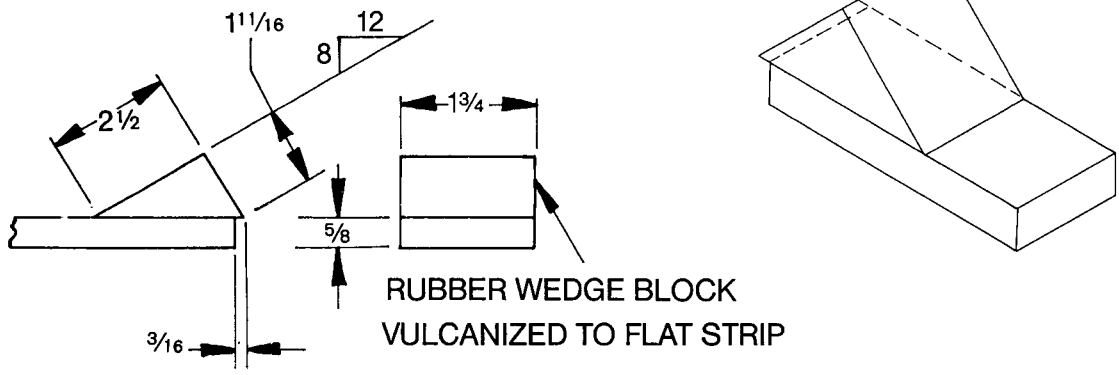


MOLD NO. 4066

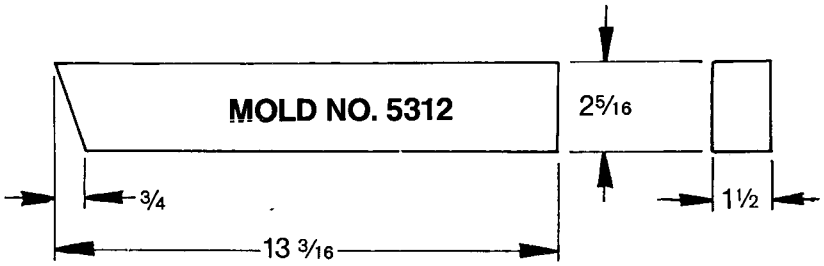


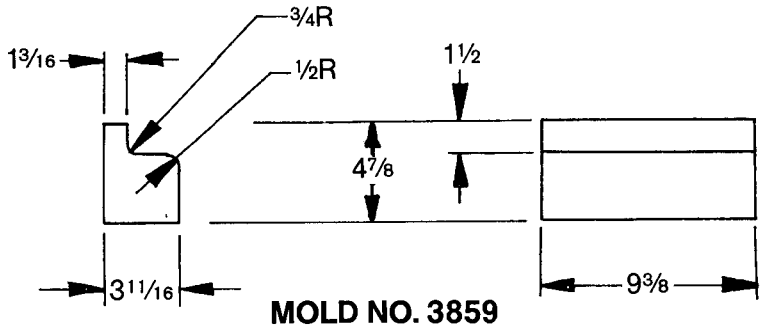
MOLDED RUBBER BLOCK
MOLD NO. 6833

MOLD NO. 4327

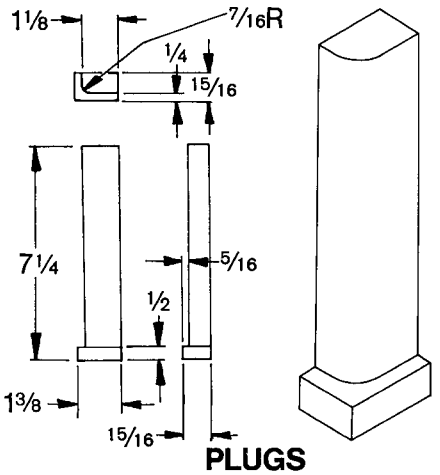


RUBBER WEDGE BLOCK
VULCANIZED TO FLAT STRIP

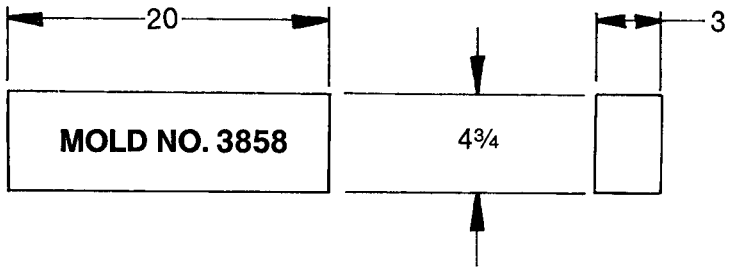




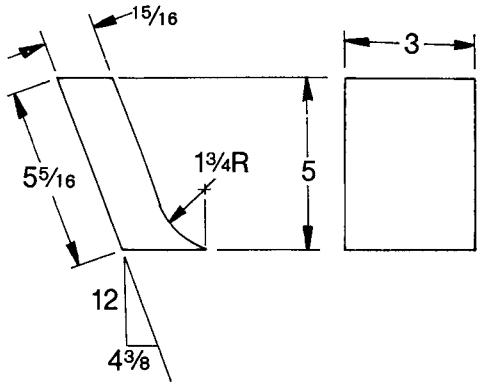
MOLD NO. 3859

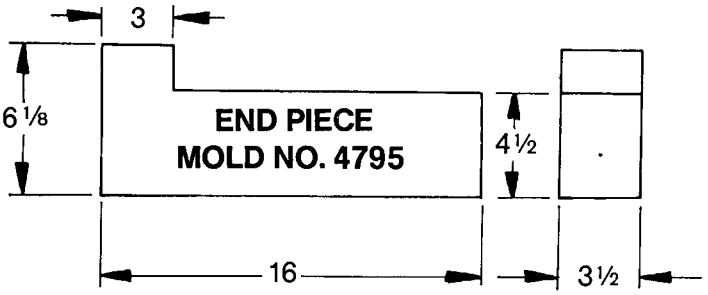


PLUGS
MOLD NO. 3554
AS SHOWN AND OPOSITE

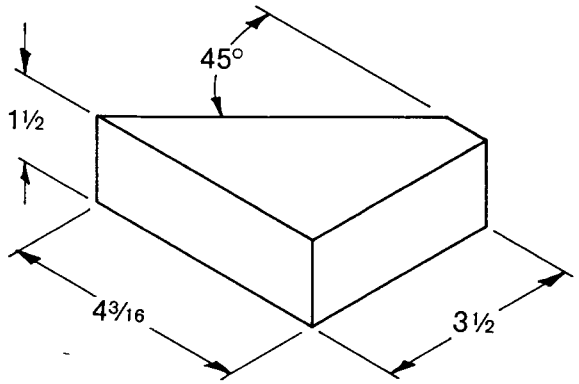


MOLD NO. 3255

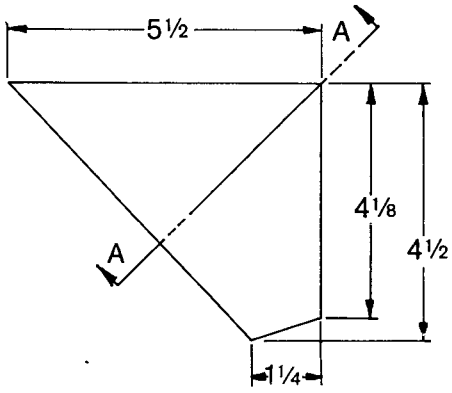




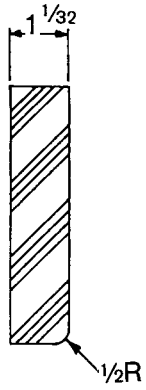
L-4



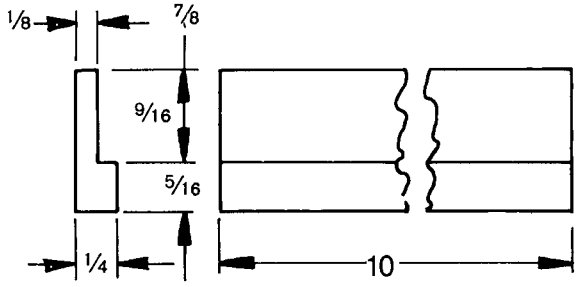
MOLDED RUBBER SEAL BLOCK
PART NO. 71D1556



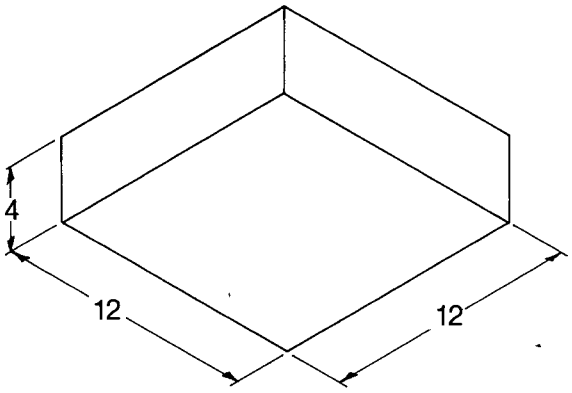
MOLD NO. 6892



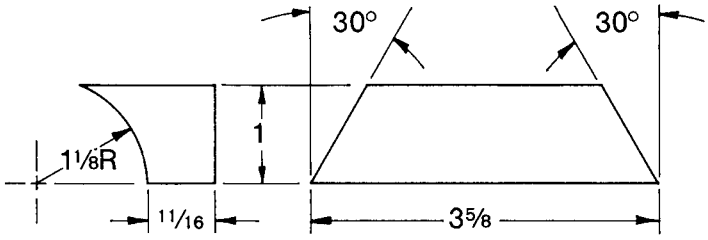
SECTION A-A



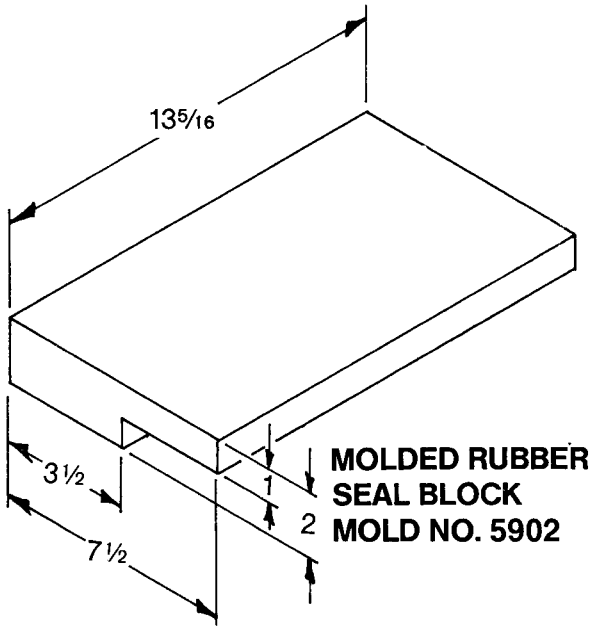
SILL CLAMP SEAL
MOLD NO. 4501
FOR USE WITH 4499 AND 4504



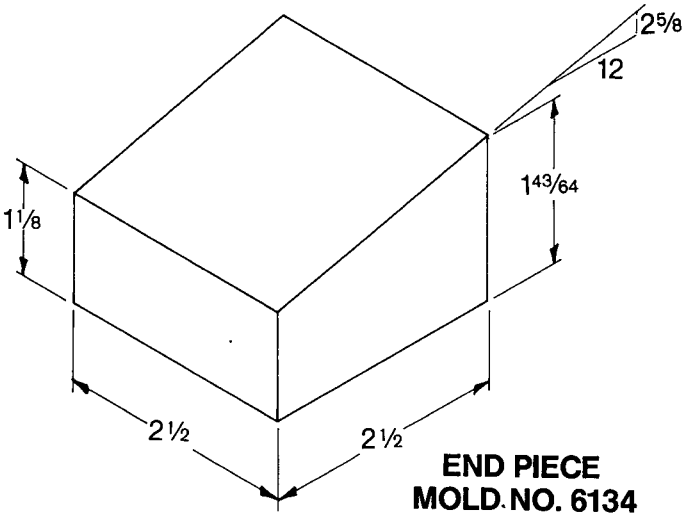
RUBBER BLOCK
MOLD NO. 6561



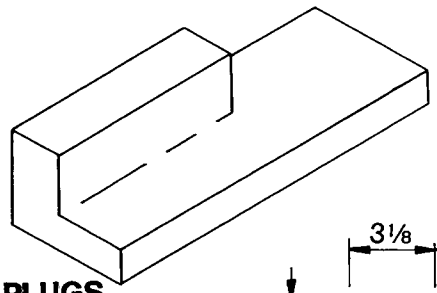
MOLD NO. 5853



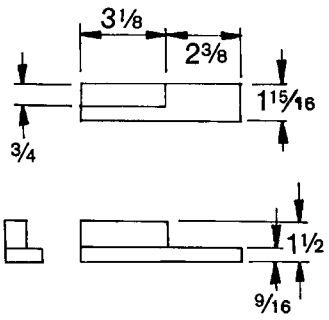
MOLDED RUBBER
SEAL BLOCK
MOLD NO. 5902

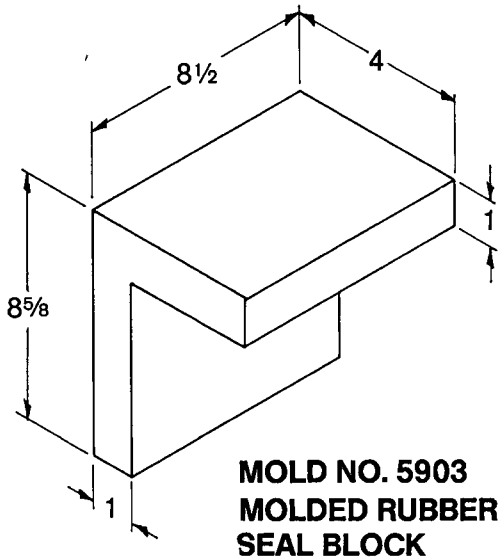


END PIECE
MOLD NO. 6134

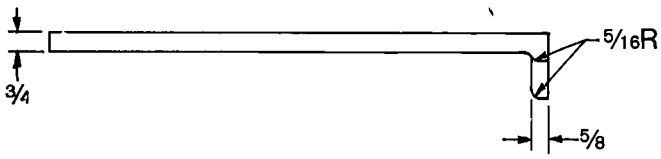


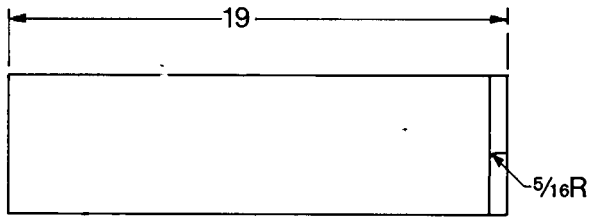
PLUGS
MOLD NO. 3513
AS SHOWN
AND OPPOSITE

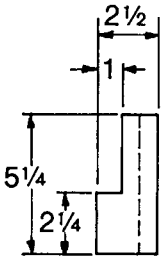


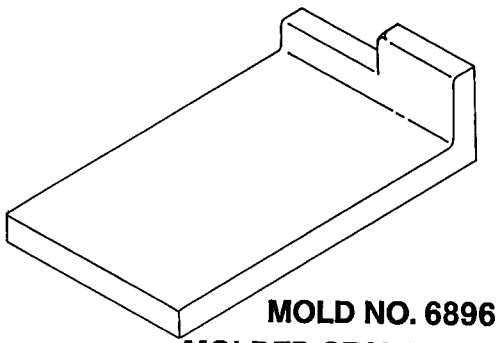


MOLD NO. 5903
MOLDED RUBBER
SEAL BLOCK

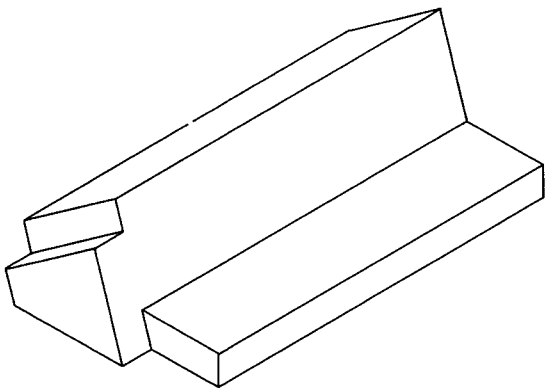


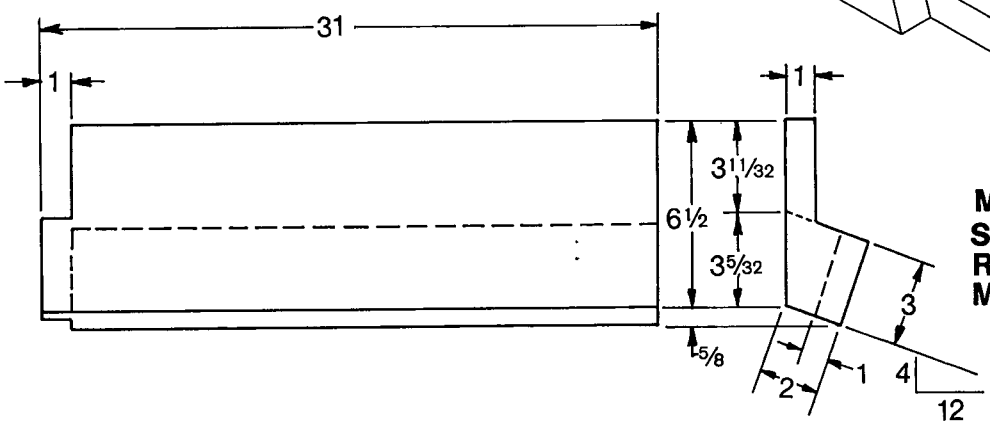






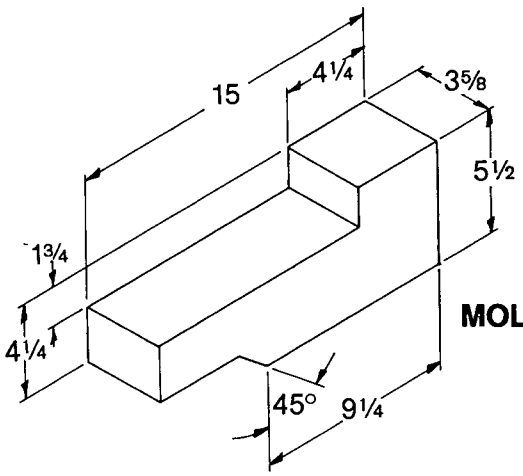
MOLD NO. 6896
MOLDED SEAL PIECE
AS SHOWN AND OPPOSITE



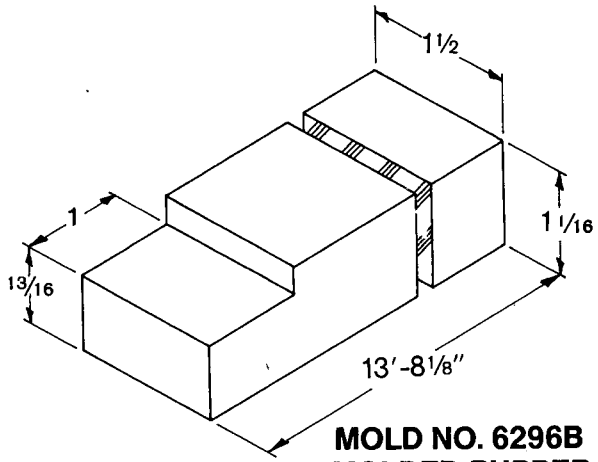


MOLD NO. 6846
SPECIAL MOLDED
RUBBER SEAL FOR
MITER GATE

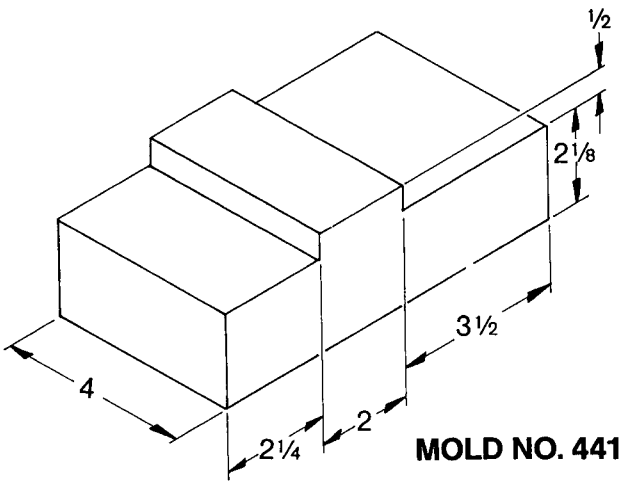
L-6



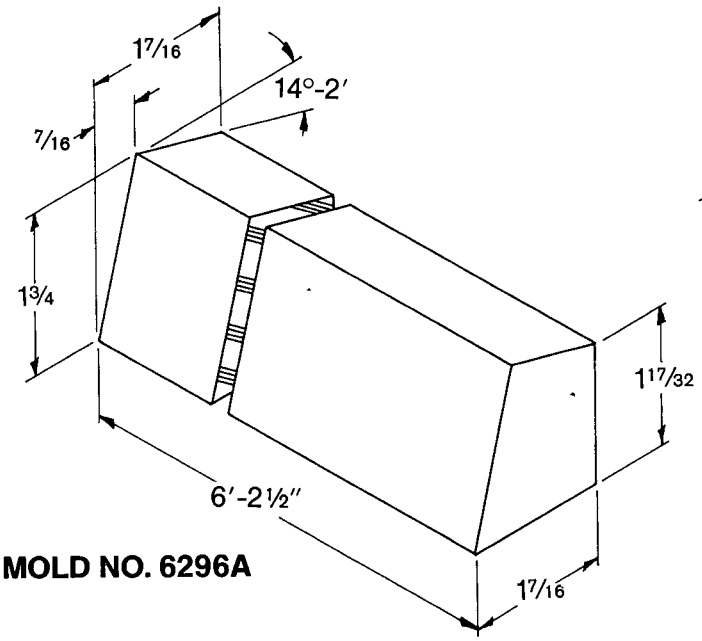
MOLD NO. 6298



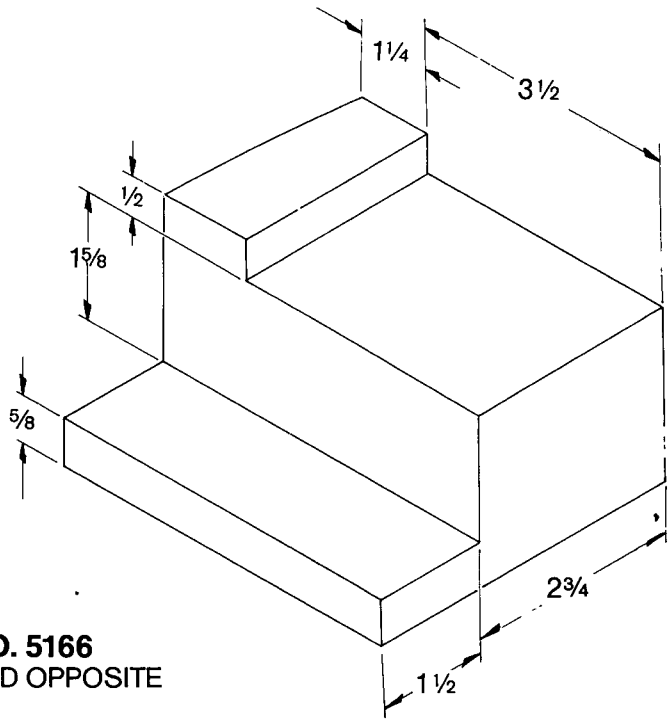
MOLD NO. 6296B
MOLDED RUBBER GATE SEALS—SPECIAL BLOCK

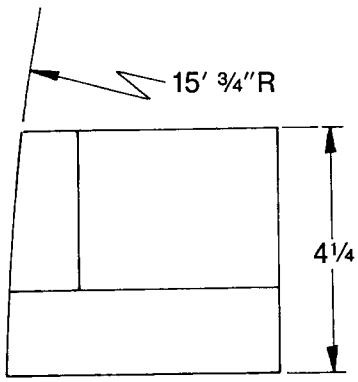


MOLD NO. 4419



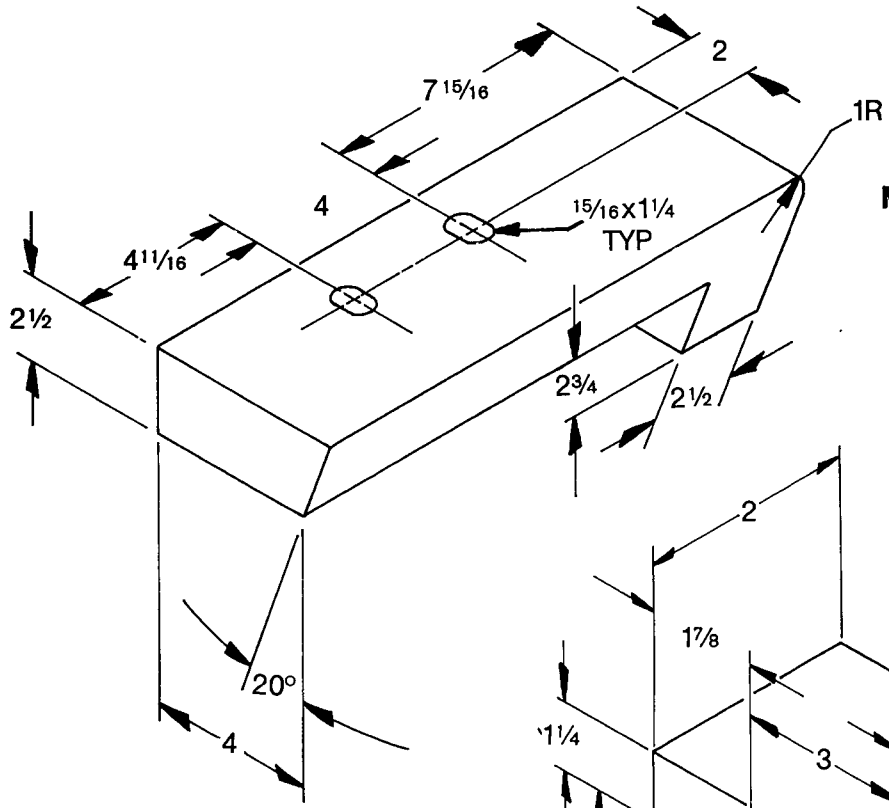
MOLD NO. 6296A



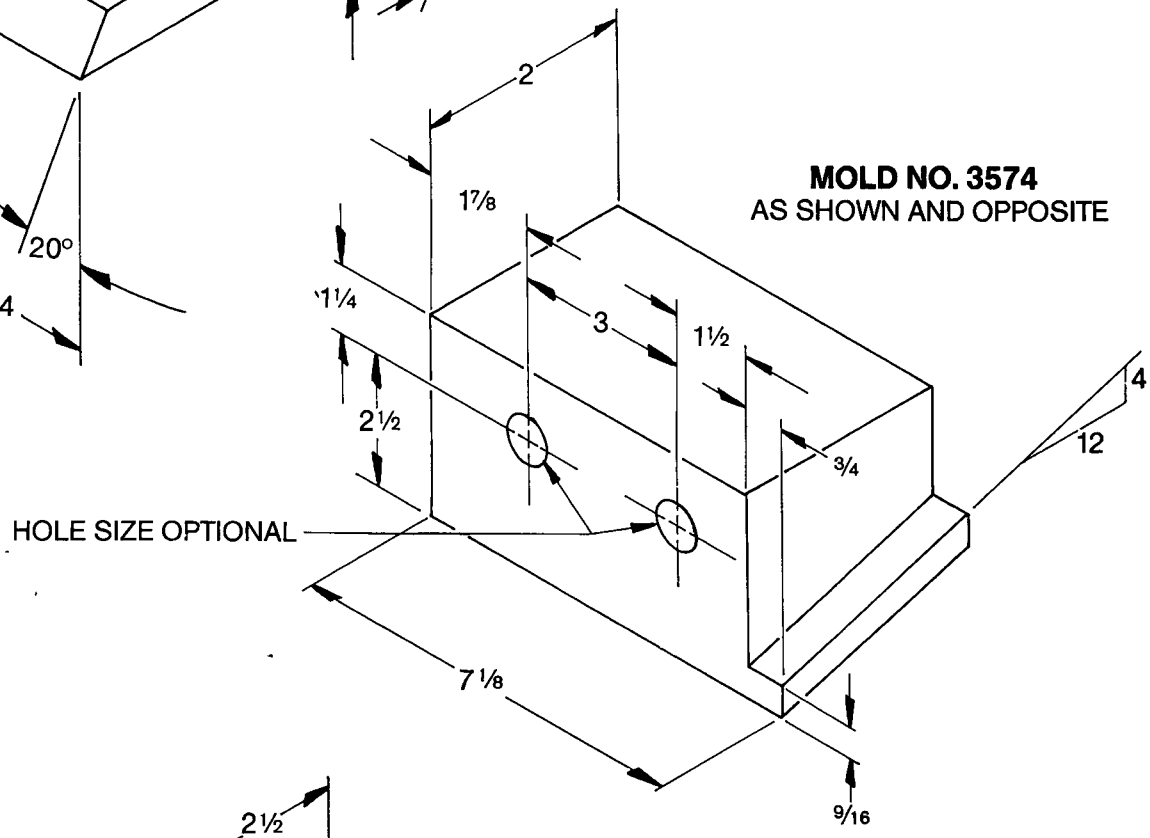


TOP VIEW

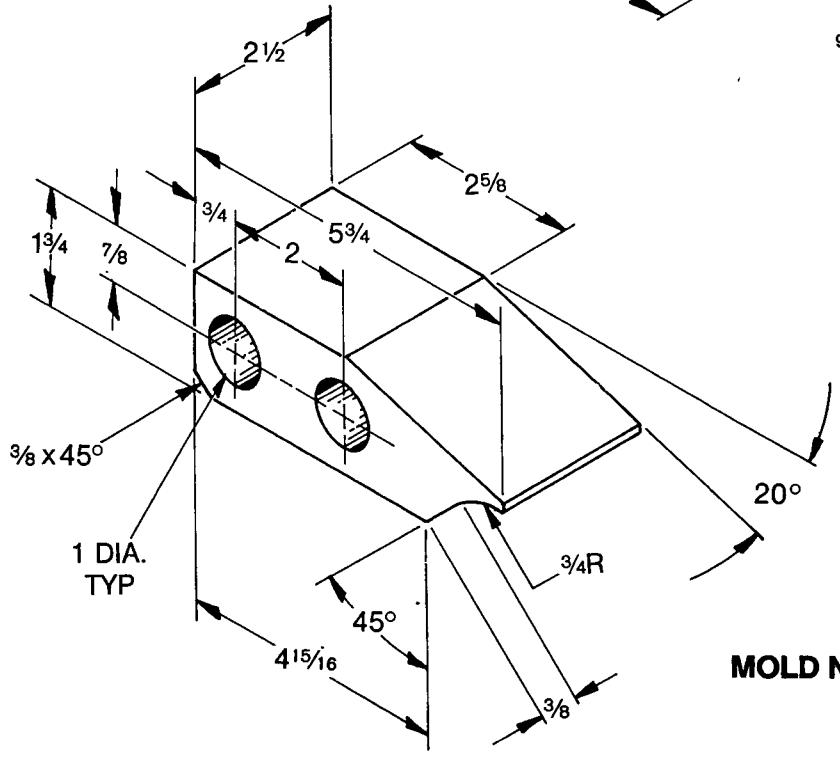
MOLD NO. 5166
AS SHOWN AND OPPOSITE



MOLD NO. 4778

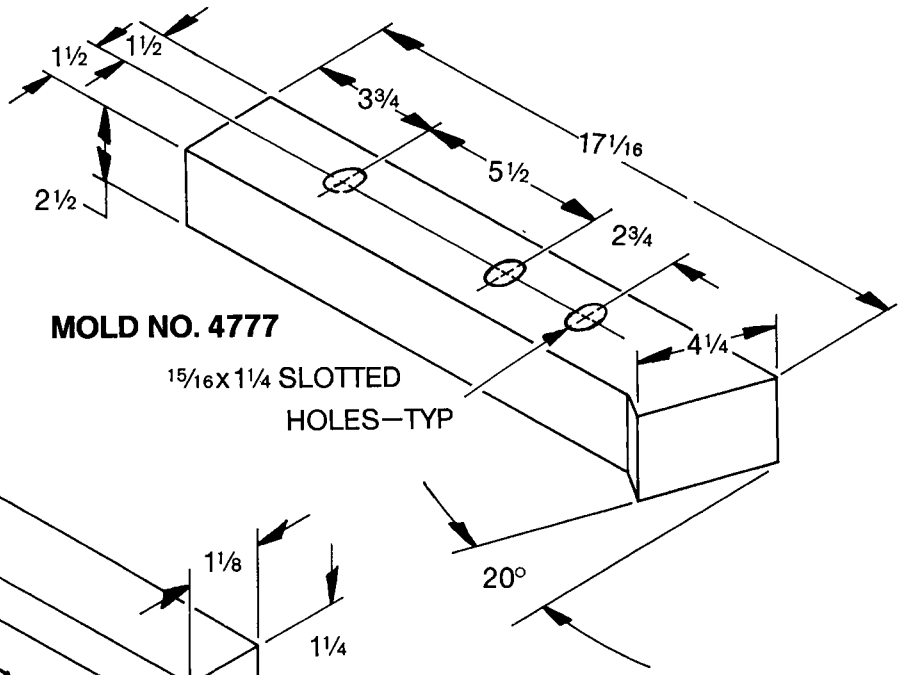


MOLD NO. 3574
AS SHOWN AND OPPOSITE

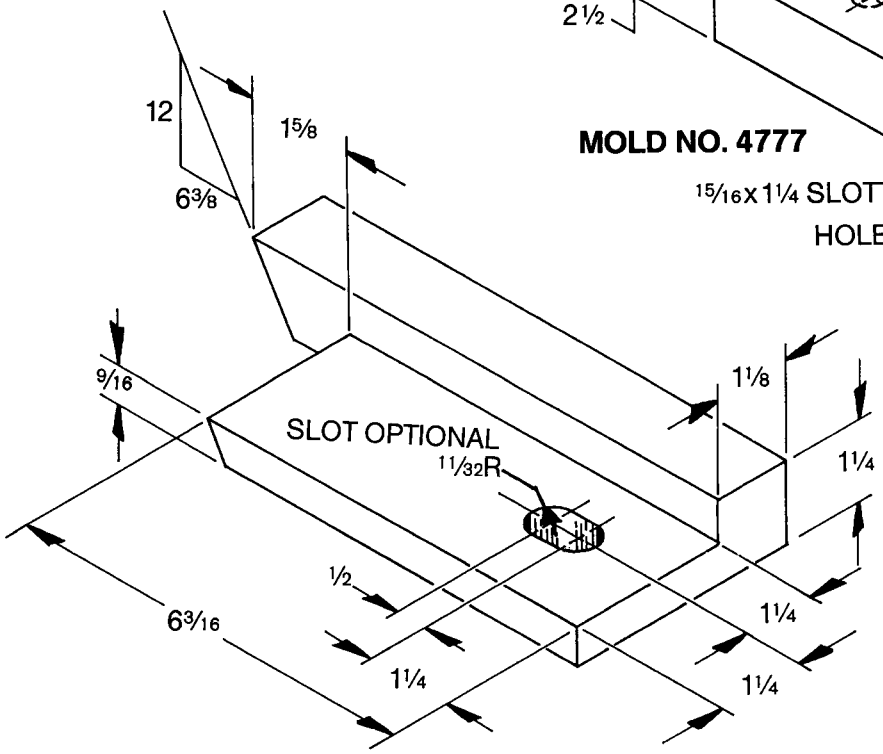


MOLD NO. 4687

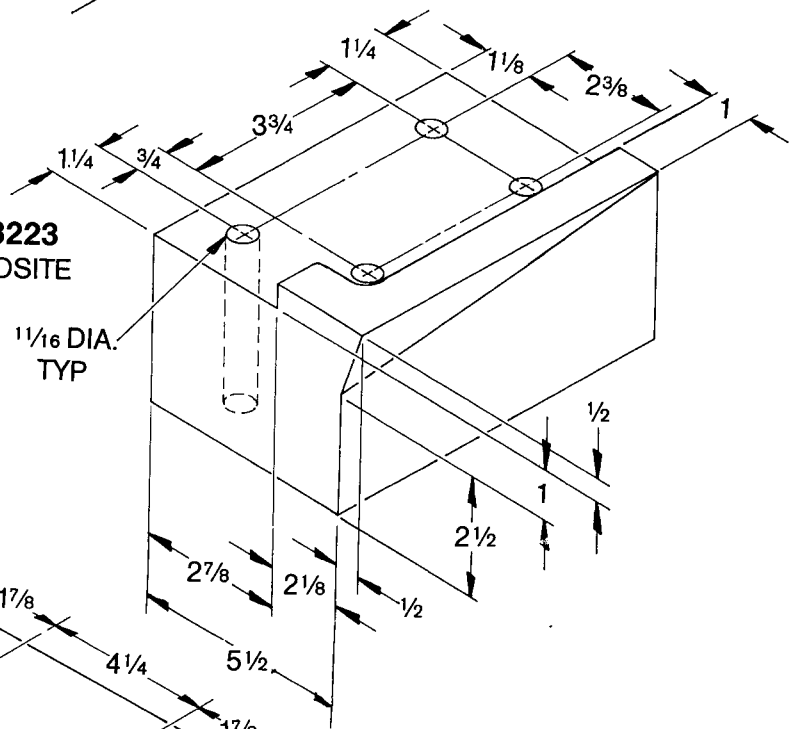
L-8



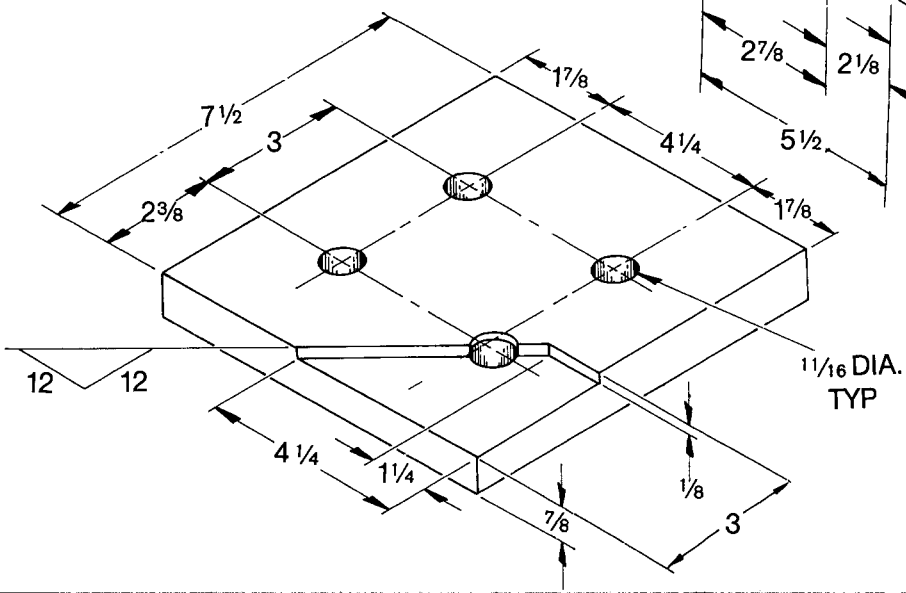
MOLD NO. 4777



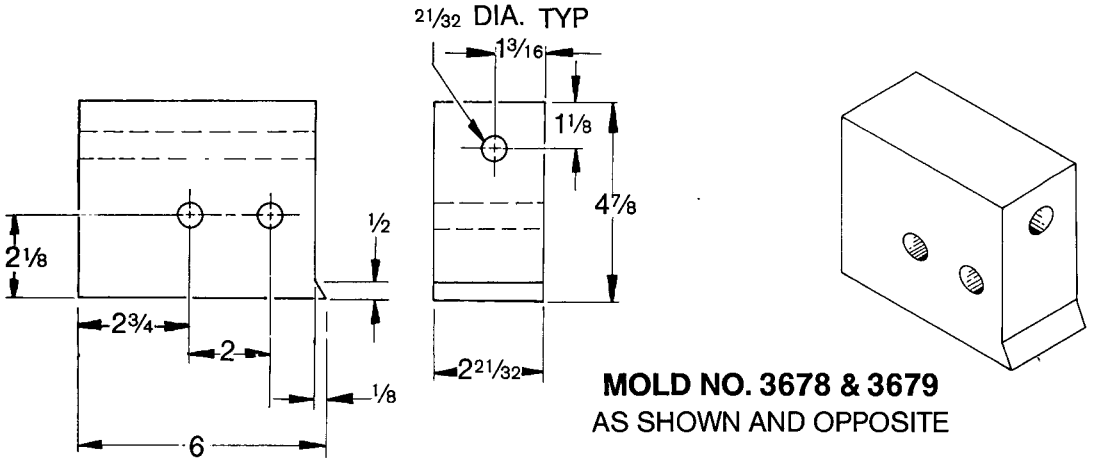
MOLD NO. 4661
AS SHOWN AND OPPOSITE



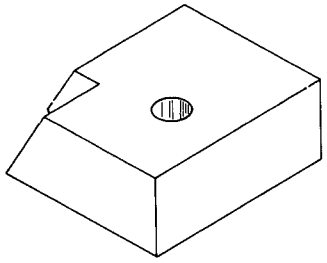
MOLD NO. 3222 & 3223
AS SHOWN AND OPPOSITE



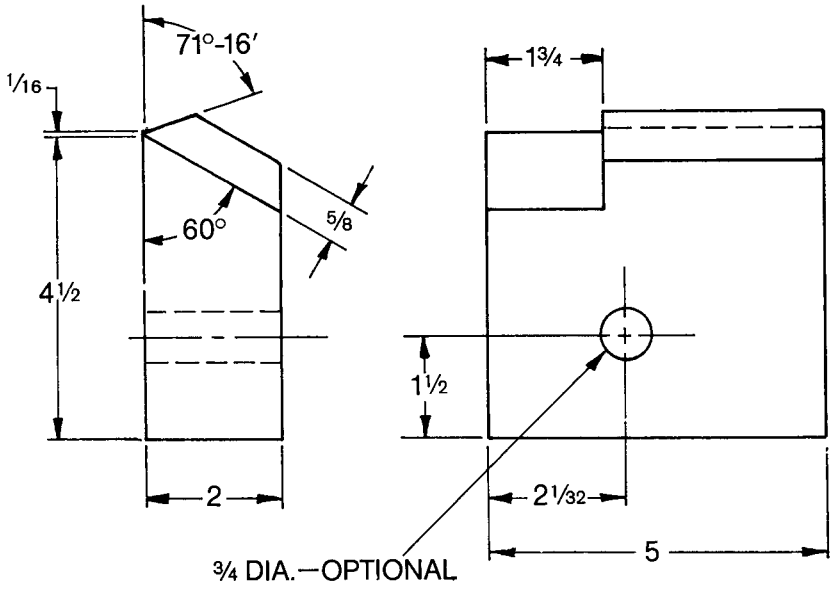
MOLD NO. 4845

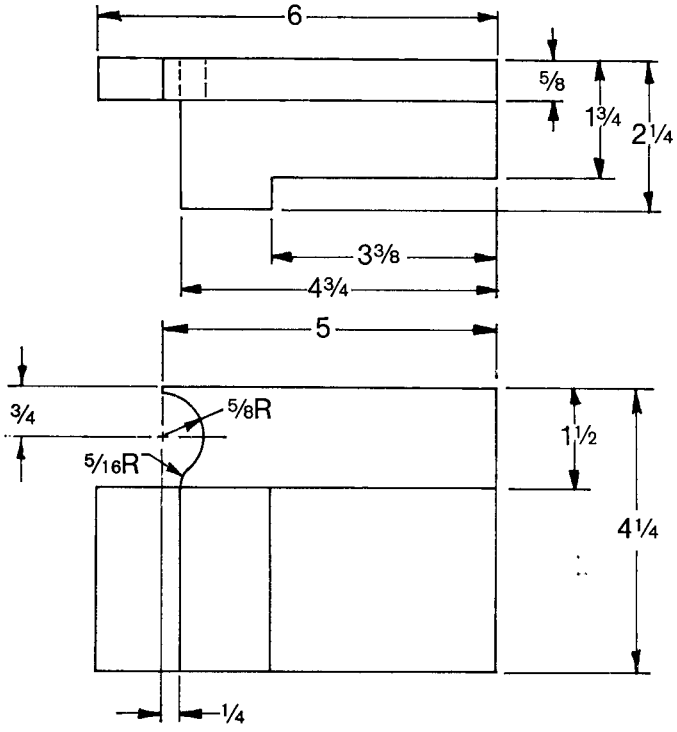


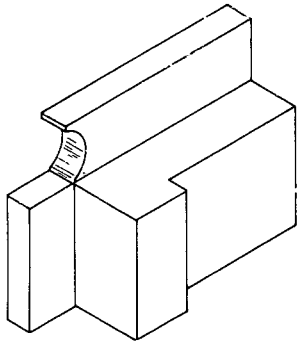
MOLD NO. 3678 & 3679
AS SHOWN AND OPPOSITE



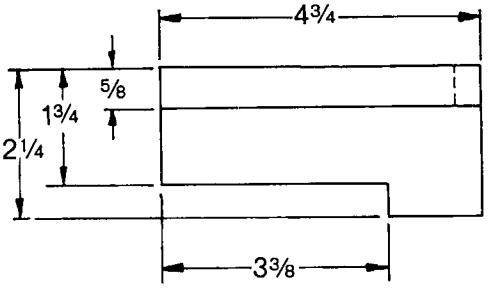
MOLD NO. 6235
AS SHOWN AND OPPOSITE

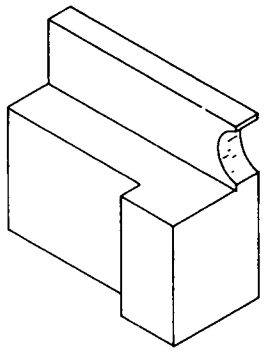


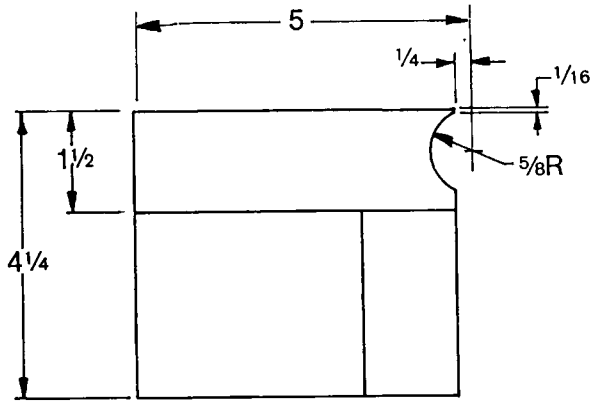




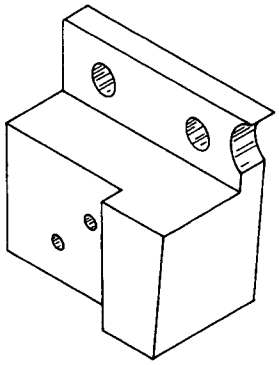
MOLD NO. 6040 & OPP.
AS SHOWN AND OPPOSITE



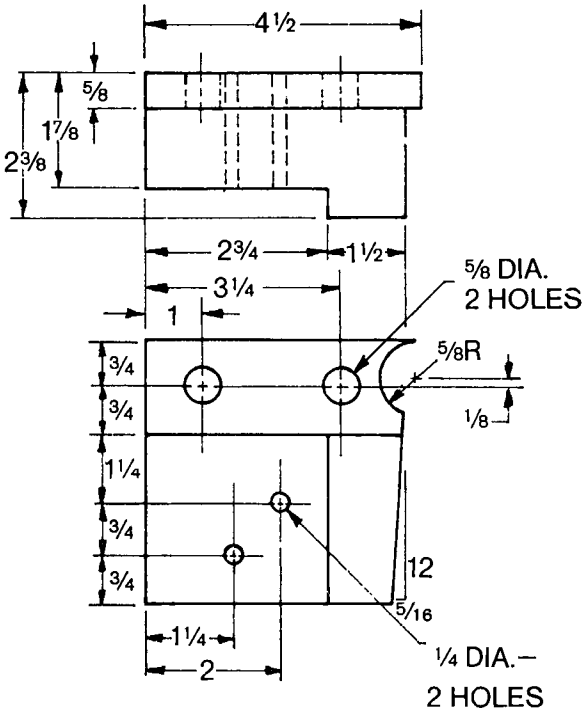


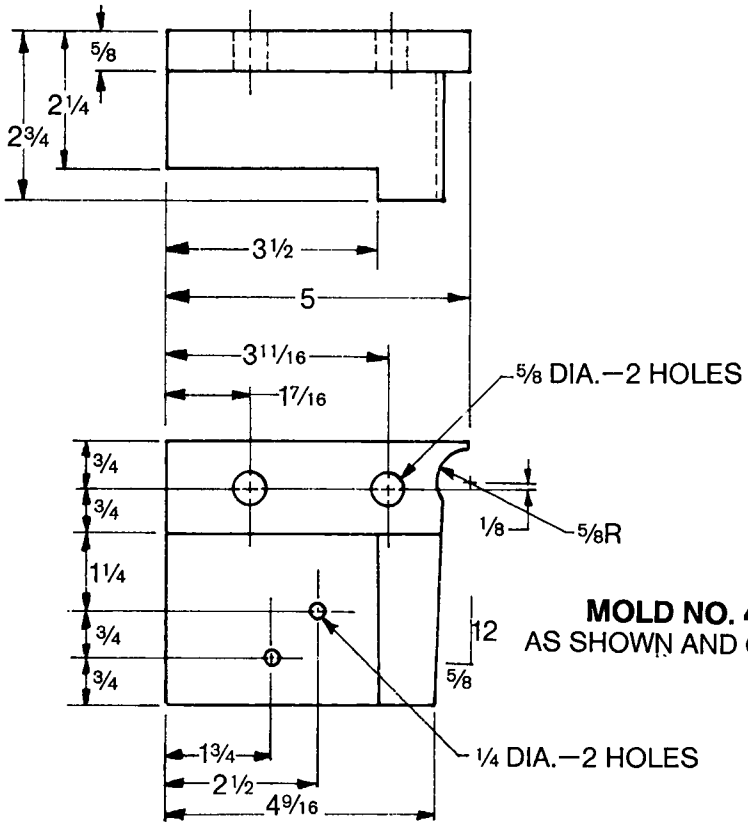


MOLD NO. 5923 & 5924
AS SHOWN AND OPPOSITE

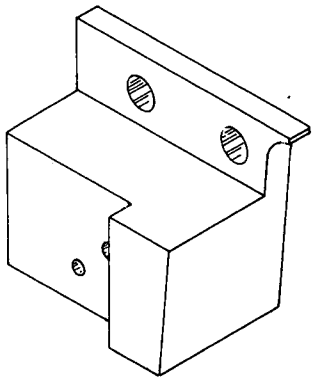


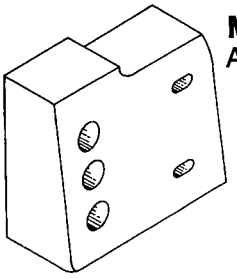
MOLD NO. 4436
AS SHOWN AND OPPOSITE



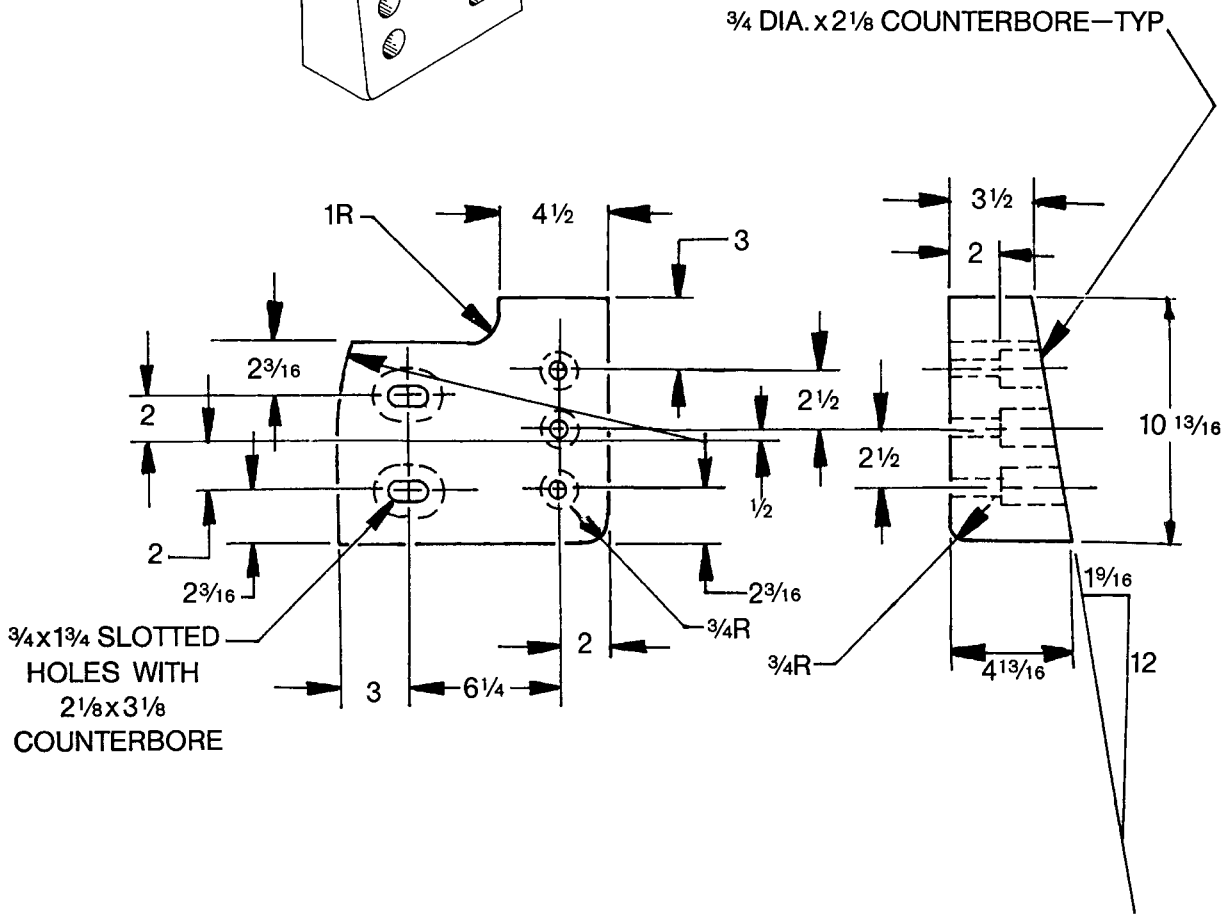


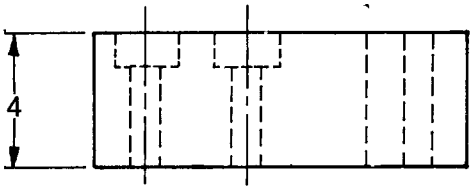
MOLD NO. 4676
AS SHOWN AND OPPOSITE

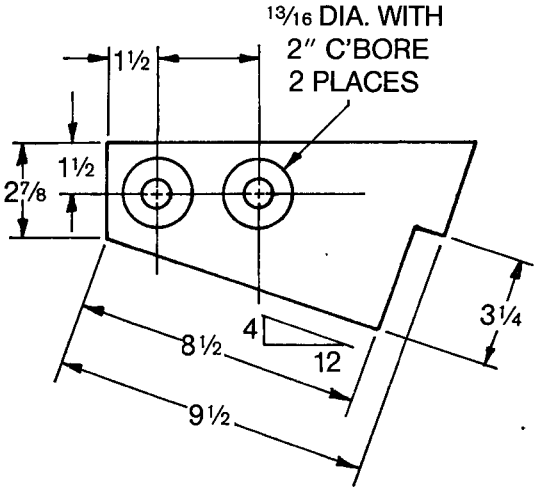




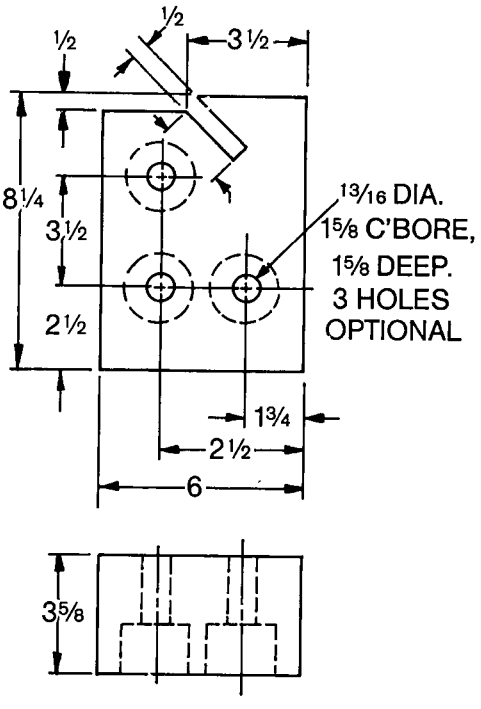
MOLD NO. 4786 & 4787
AS SHOWN AND OPPOSITE





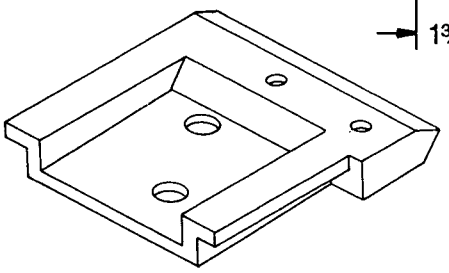


MOLD NO. 6798

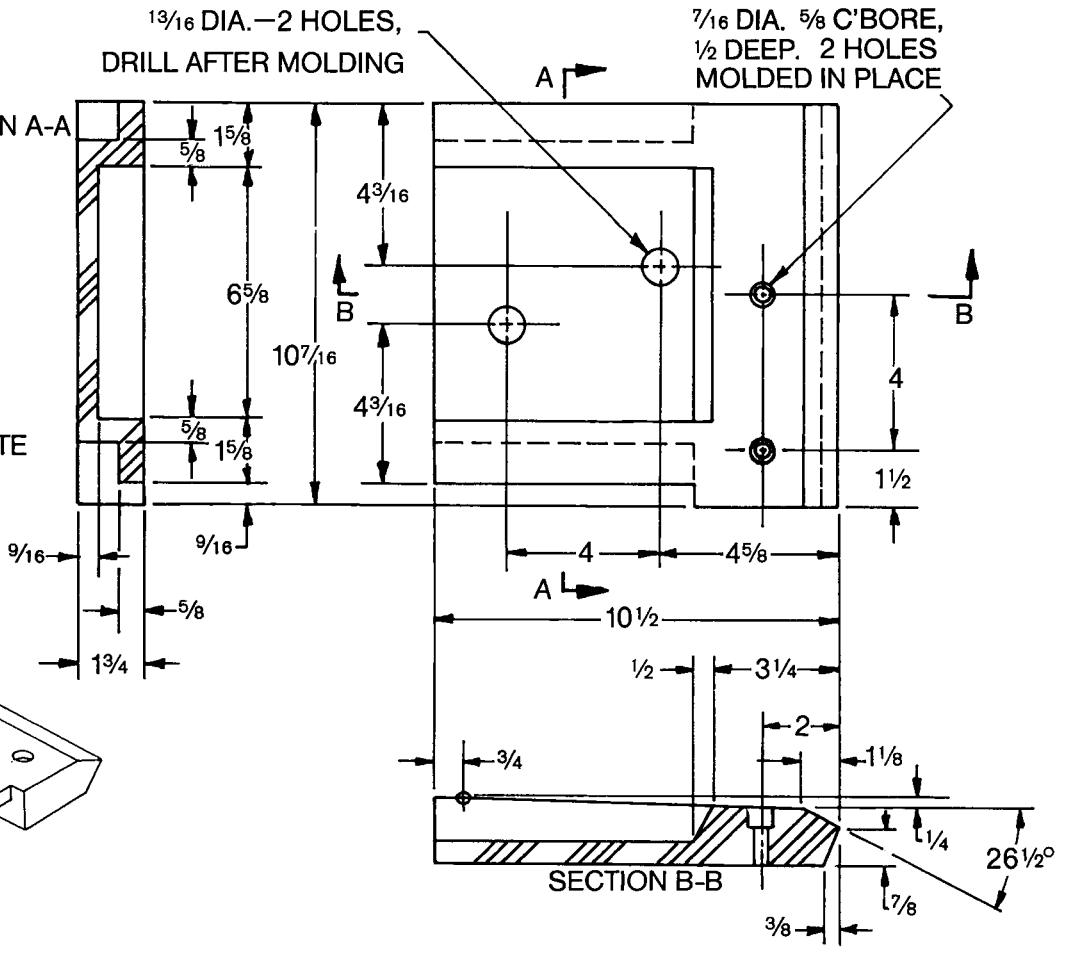


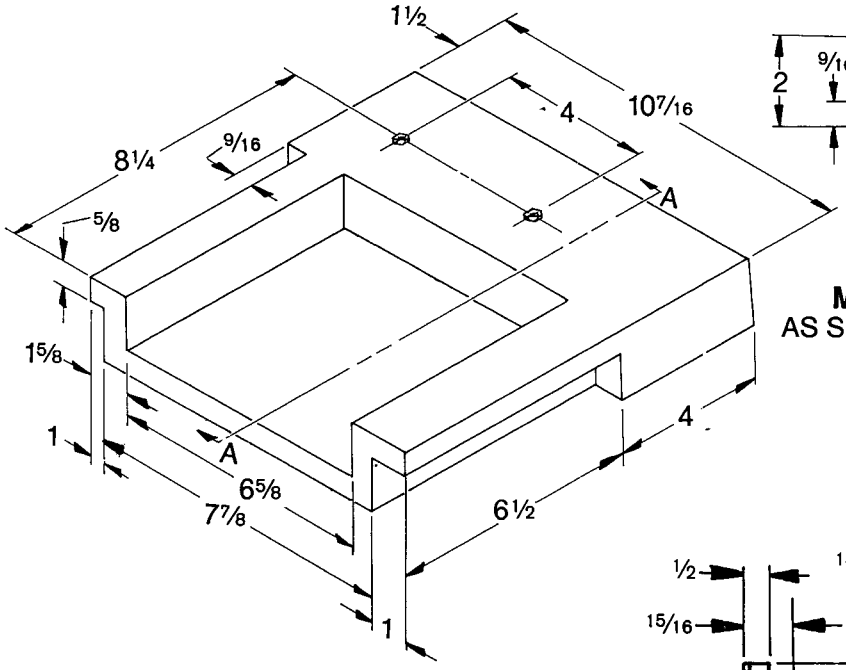
MOLD NO. 6424
AS SHOWN AND OPPOSITE

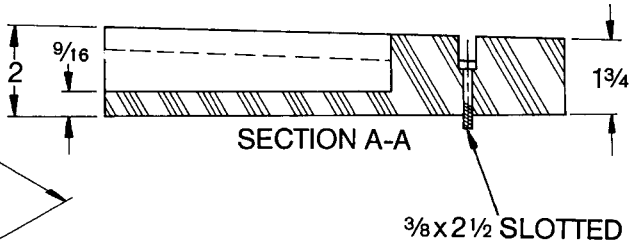
L-12



MOLD NO. 6329
AS SHOWN AND OPPOSITE

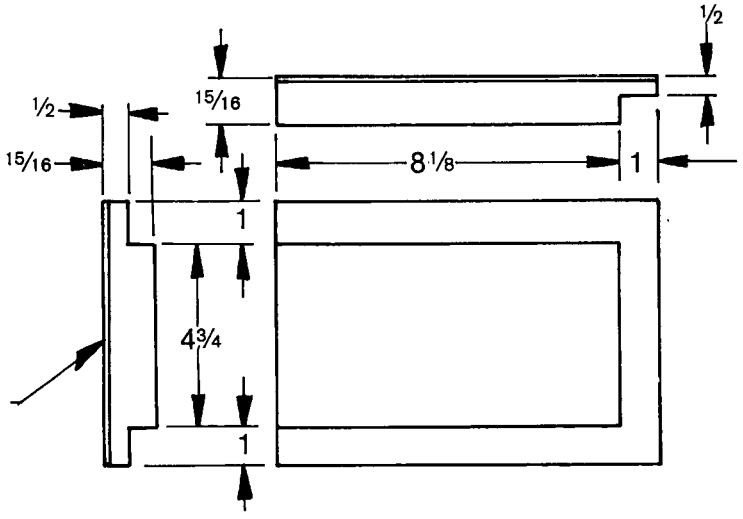






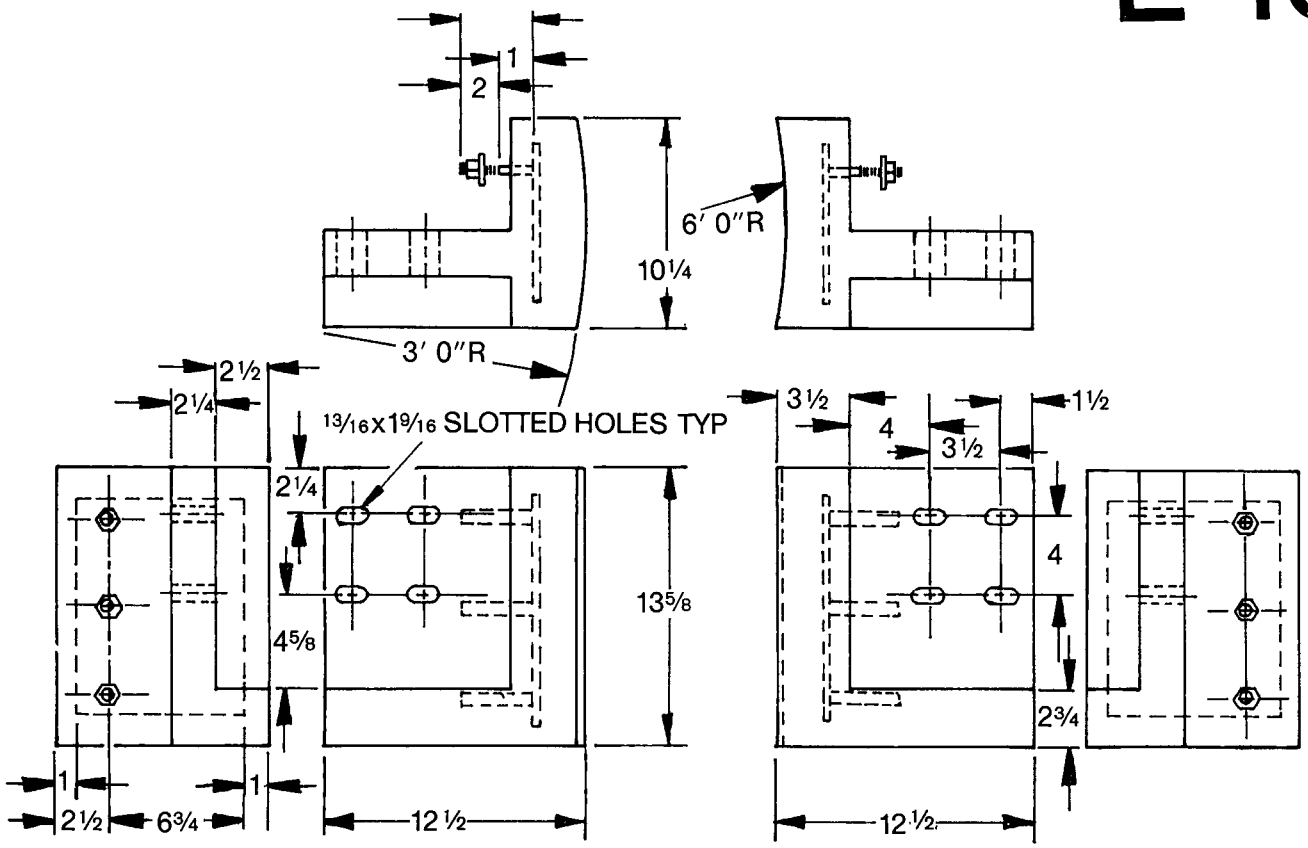
3/8 x 2 1/2 SLOTTED HEX-HEAD MONEL BOLTS INTO RUBBER

MOLD NO. 4617
AS SHOWN AND OPPOSITE



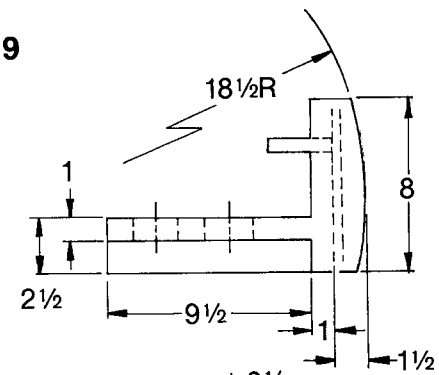
MOLD NO. 4502

1/16 MIN.-HARD OR HALF-HARD BRASS

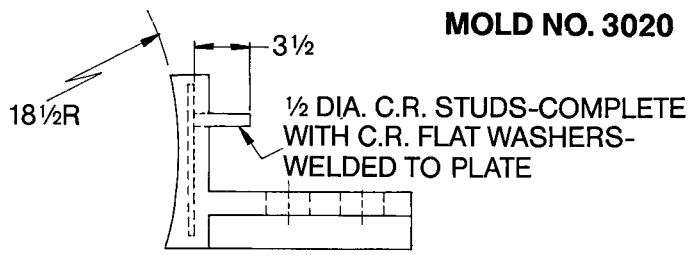


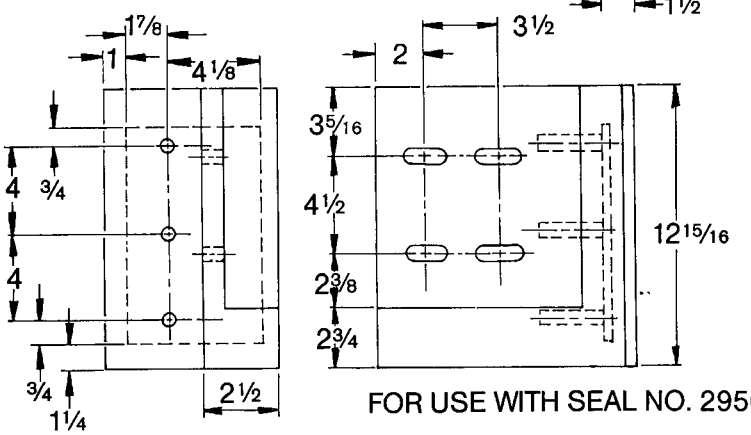
MOLD NO. 4750 & 4751

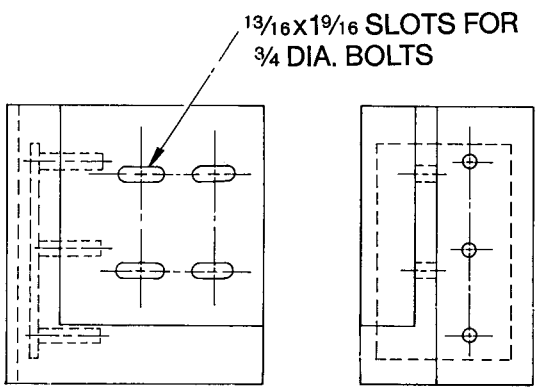
MOLD NO. 3019



MOLD NO. 3020

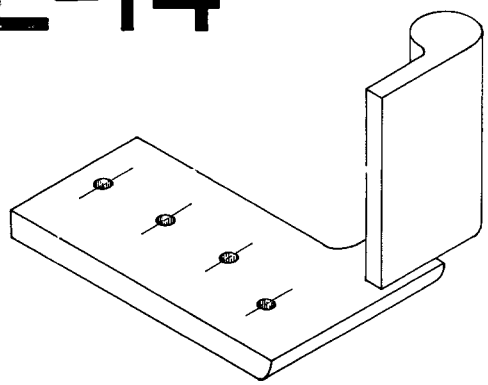


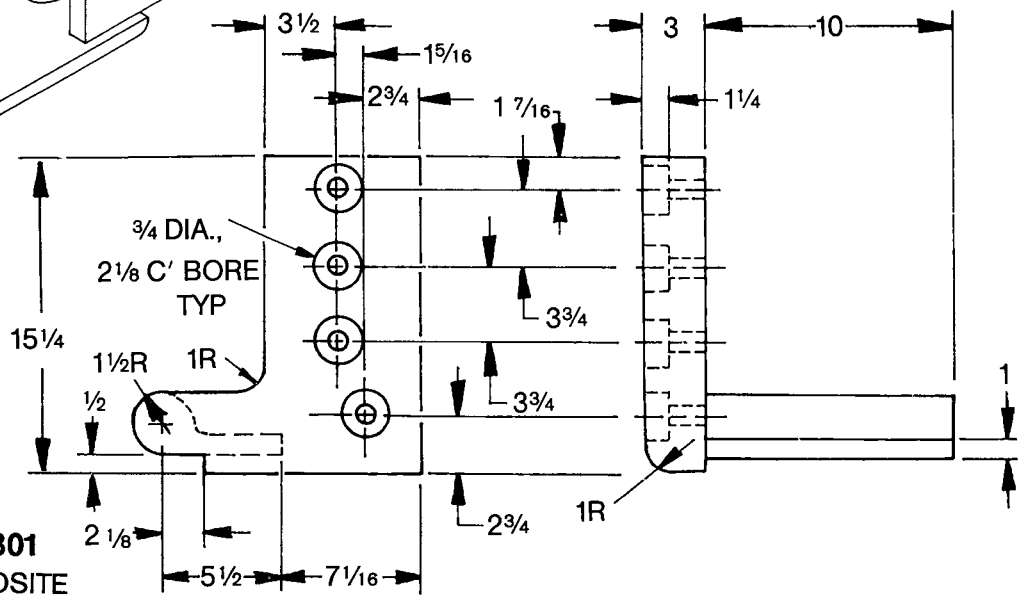




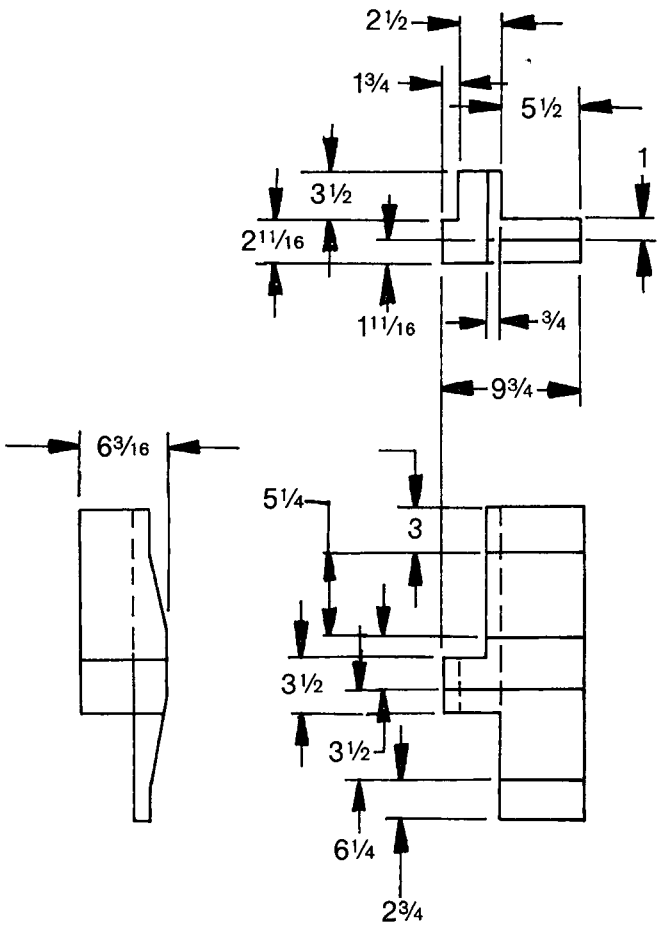
FOR USE WITH SEAL NO. 2950, PG. A-1, 2¾x7x1

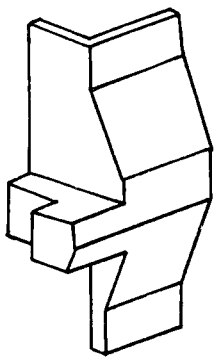
L-14



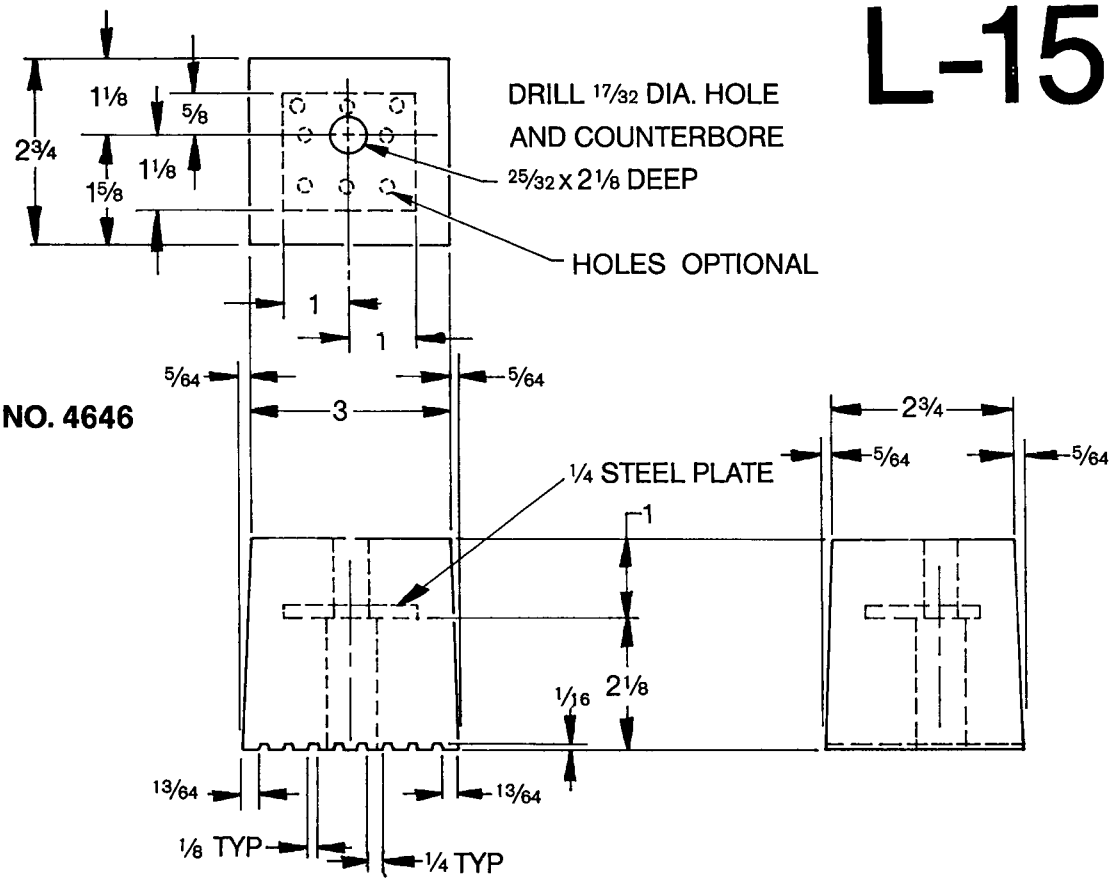


MITER SEALS
MOLD NO. 4800 & 4801
AS SHOWN AND OPPOSITE

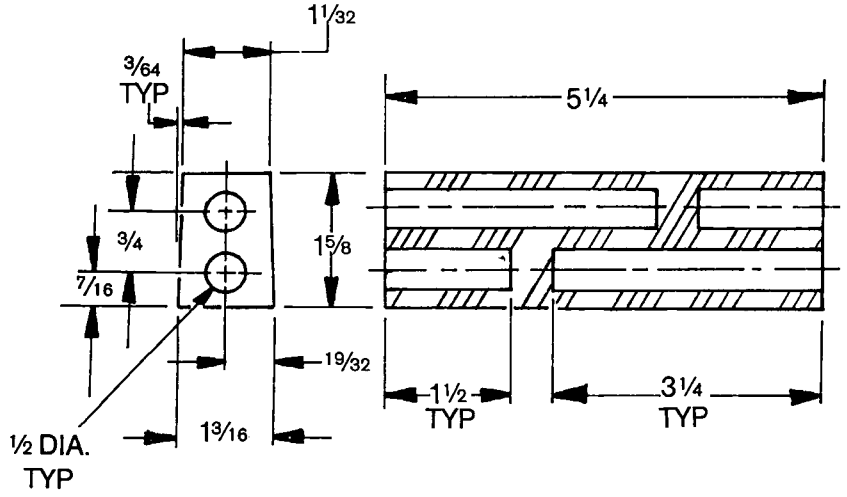




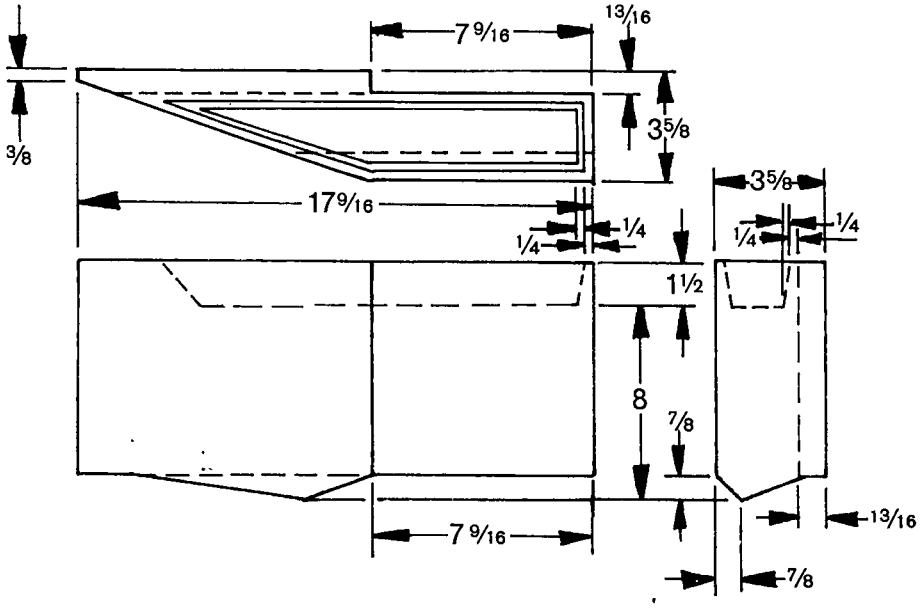
END PIECE
MOLD NO. 4068 & 4069
AS SHOWN AND OPPOSITE



MOLD NO. 4646

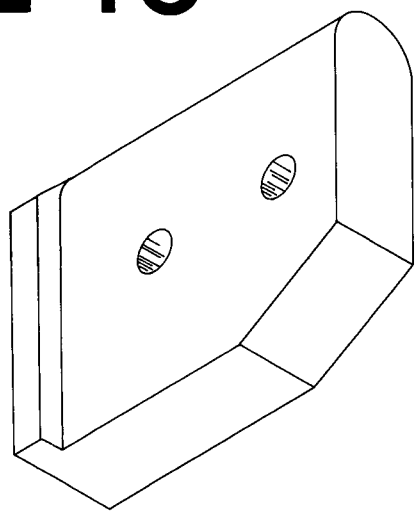


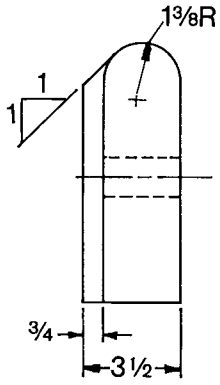
MOLD NO. 5335

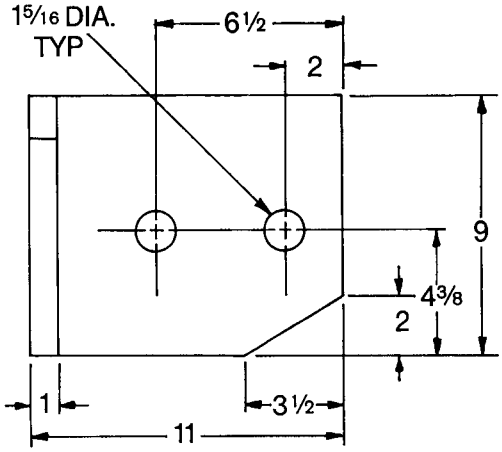


MOLD NO. 4264

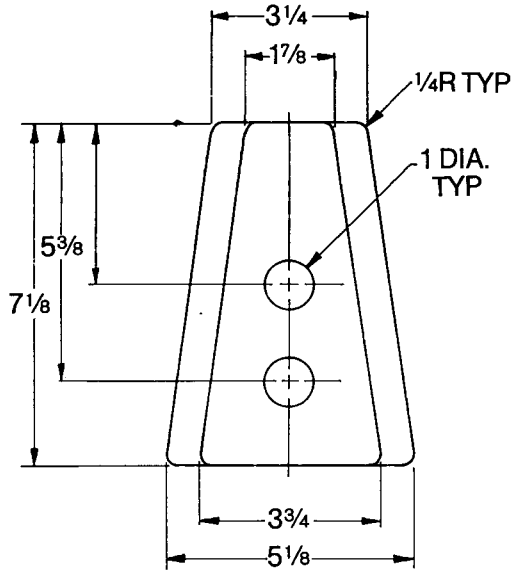
AS SHOWN AND OPPOSITE

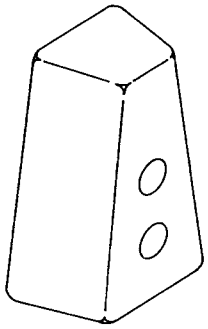




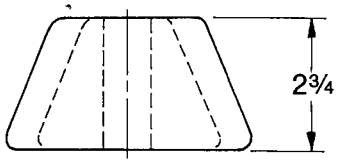


MOLD NO. 6804 & 6805
AS SHOWN AND OPPOSITE

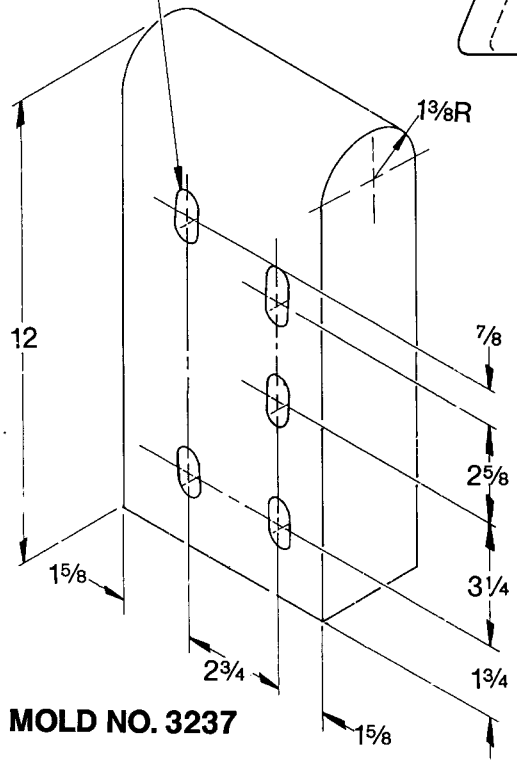




MOLD NO. 6776



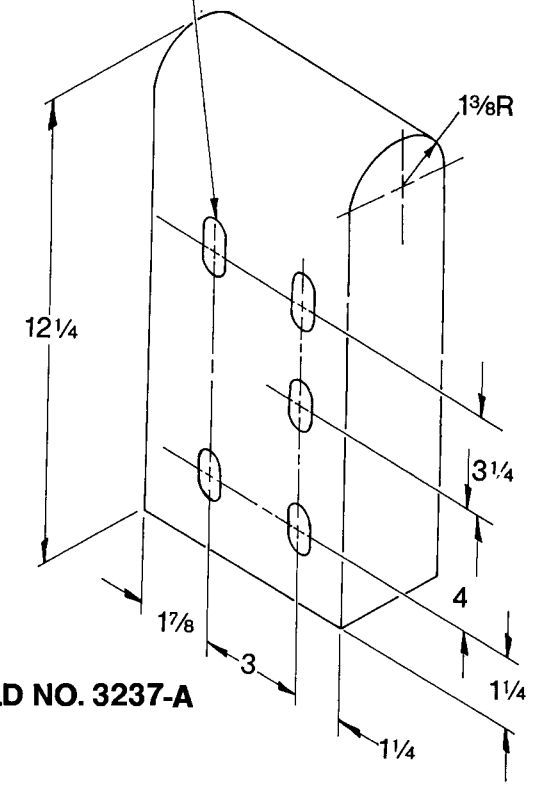
13/16 X 1 1/4
SLOTTED HOLES



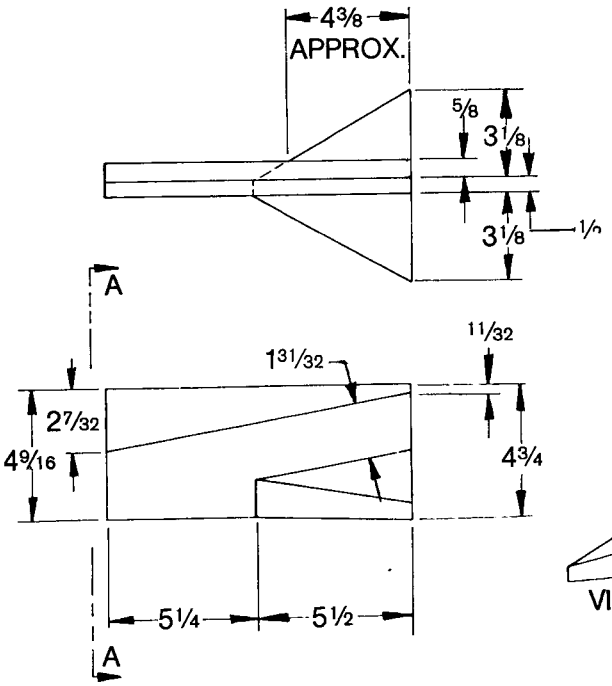
MOLD NO. 3237

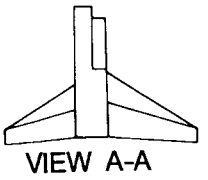
13/16 X 1 1/4
SLOTTED HOLES

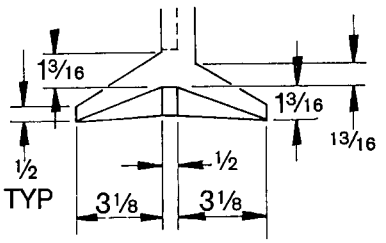
ALSO AVAILABLE
WITH 1 DIA. HOLES



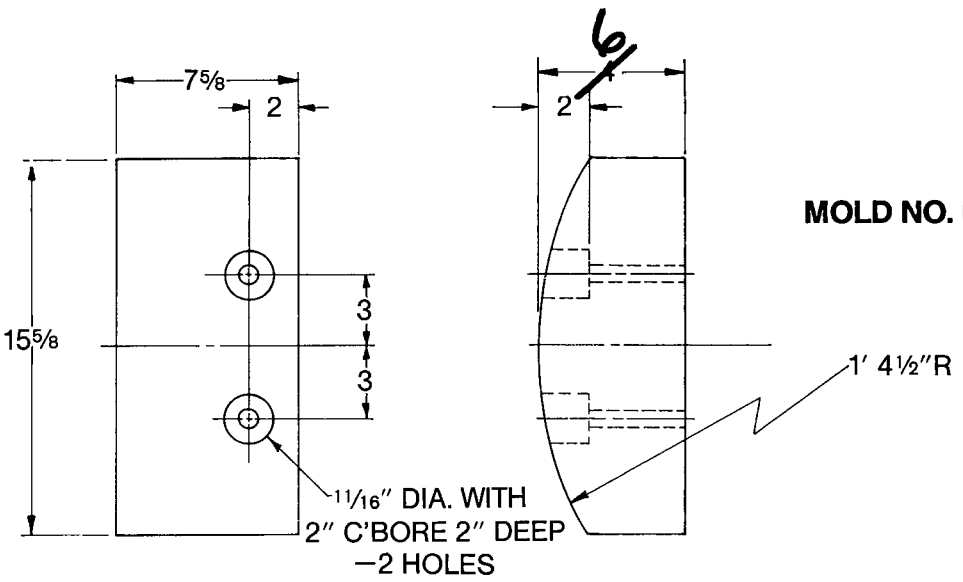
MOLD NO. 3237-A



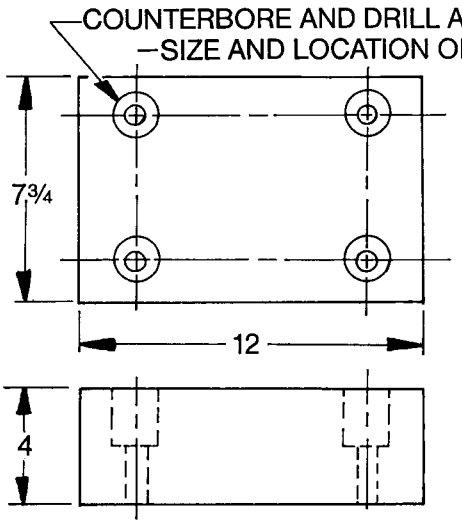




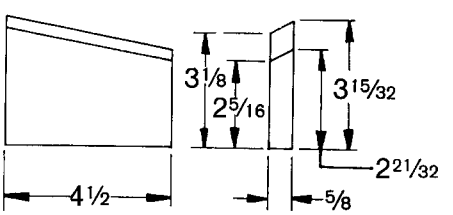
MOLD NO. 5048 & 5049
AS SHOWN AND OPOSITE



MOLD NO. 6797

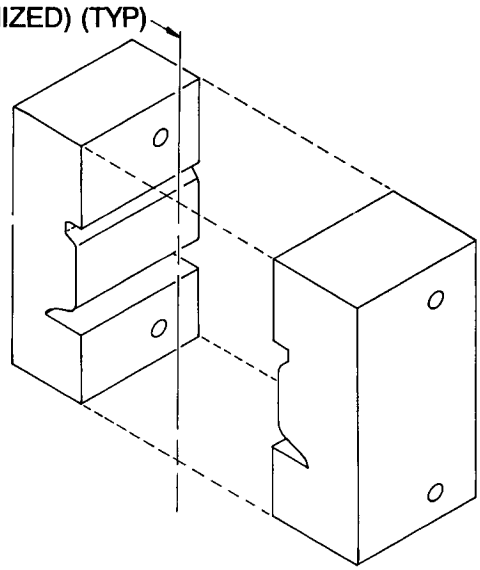


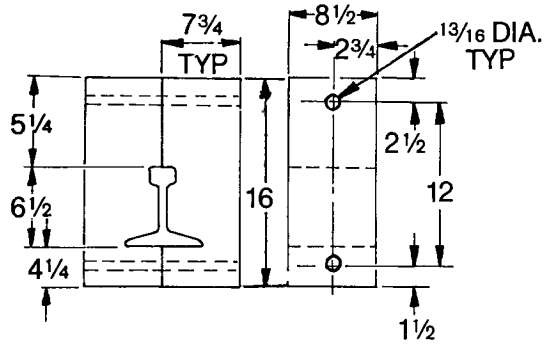
MOLD NO. 5475



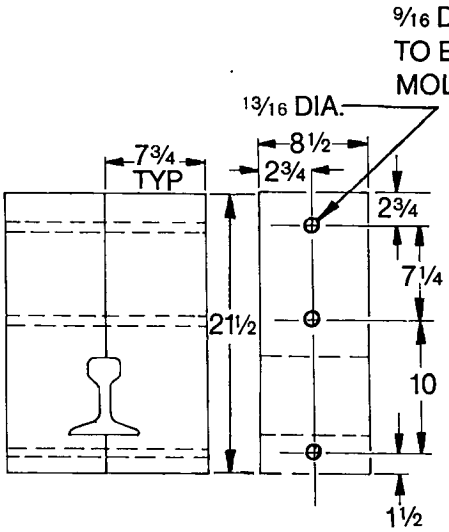
MOLD NO. 5038
AS SHOWN AND OPPOSITE

L-18

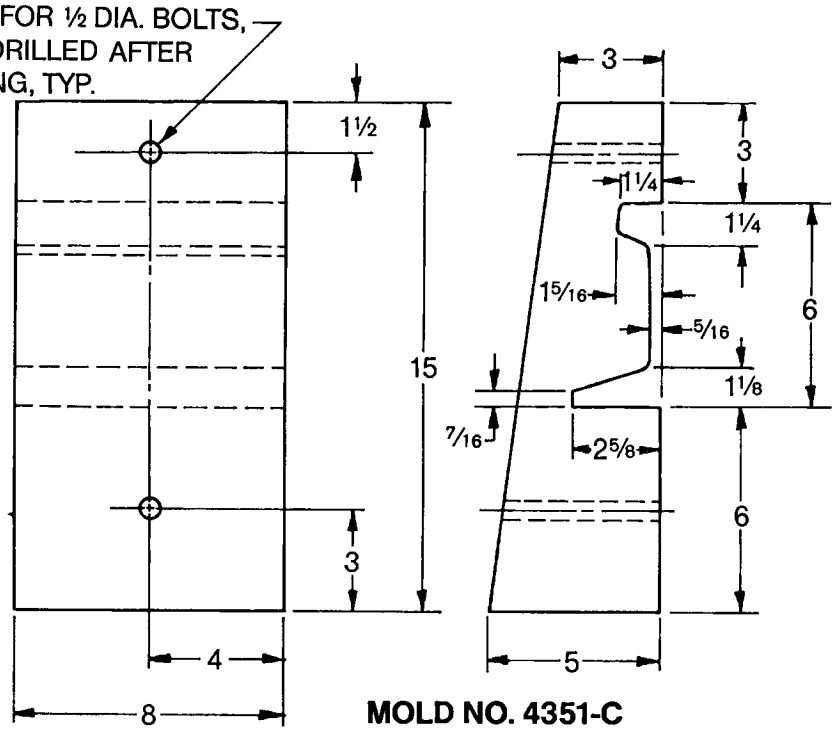




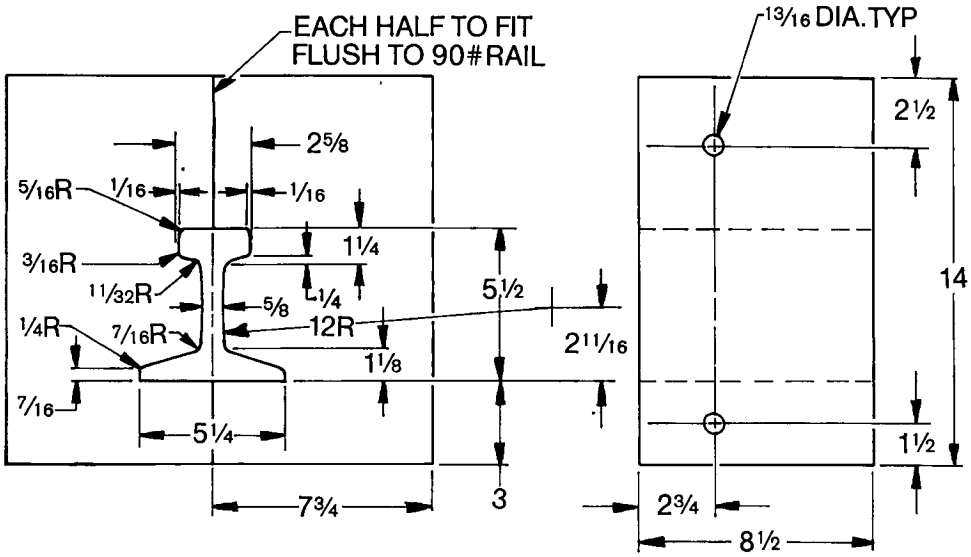
MOLD NO. 4351-A



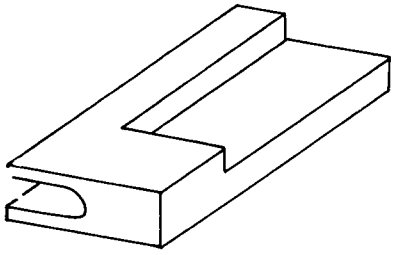
MOLD NO. 4351
EACH HALF TO FIT FLUSH
TO 100# A.R.E.A. RAIL

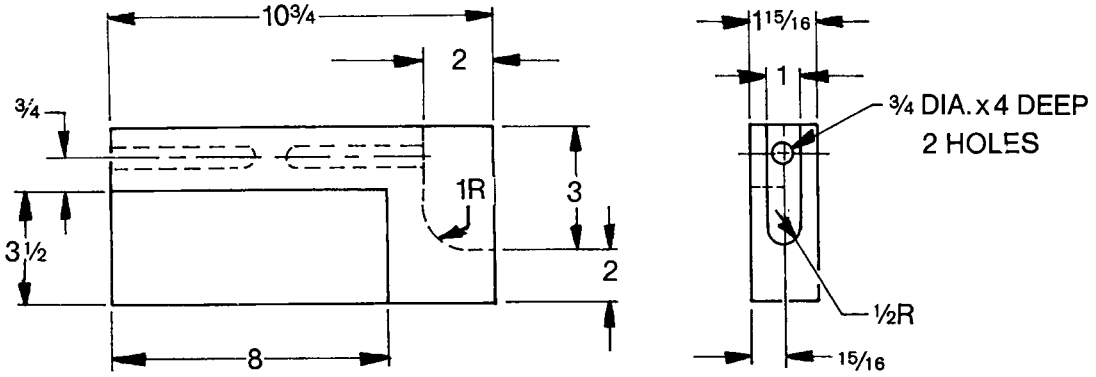


MOLD NO. 4351-C
USED IN PAIRS—ONE
ON EACH SIDE OF RAIL

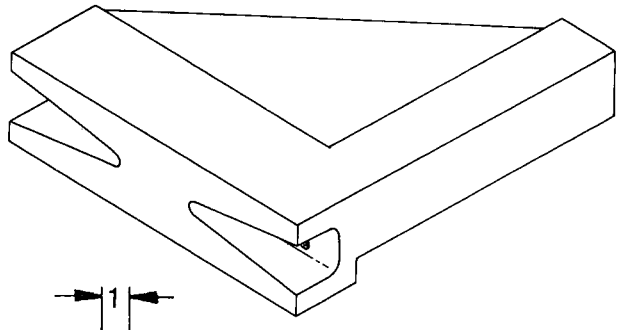


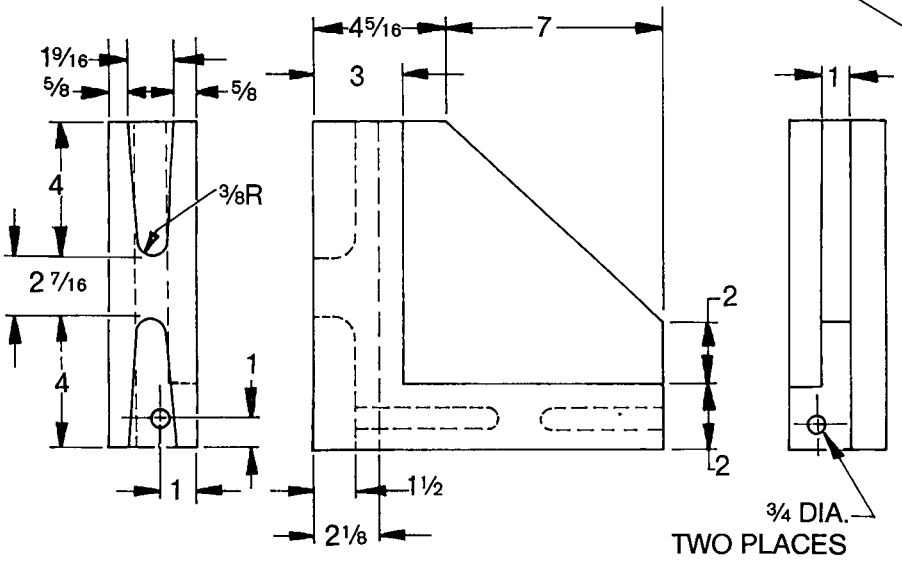
MOLD NO. 4351-B



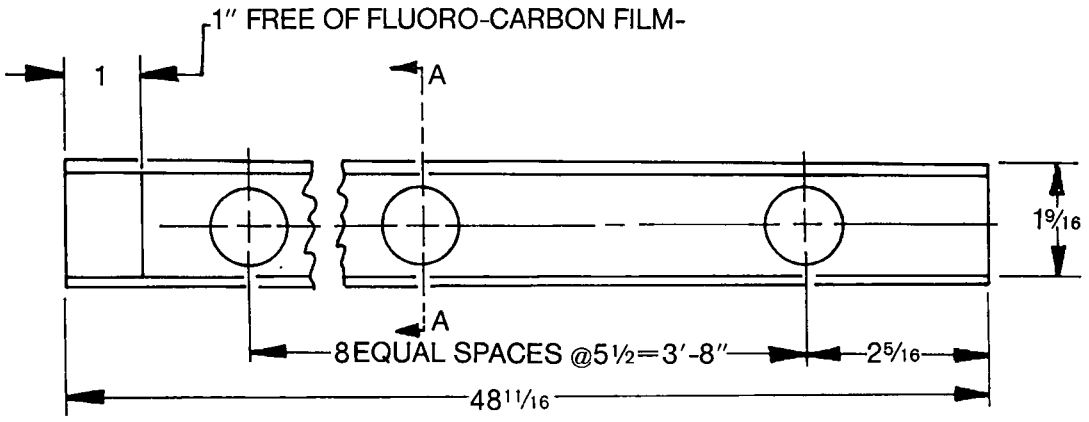


MOLD NO. 4616
AS SHOWN AND OPPOSITE

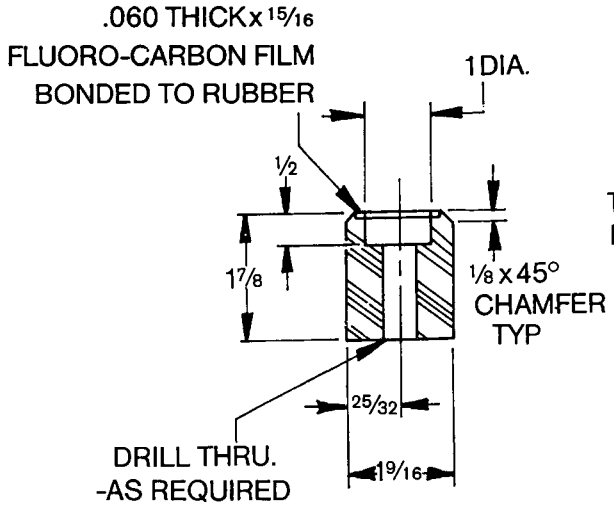




MOLD NO. 4618
AS SHOWN AND OPPOSITE

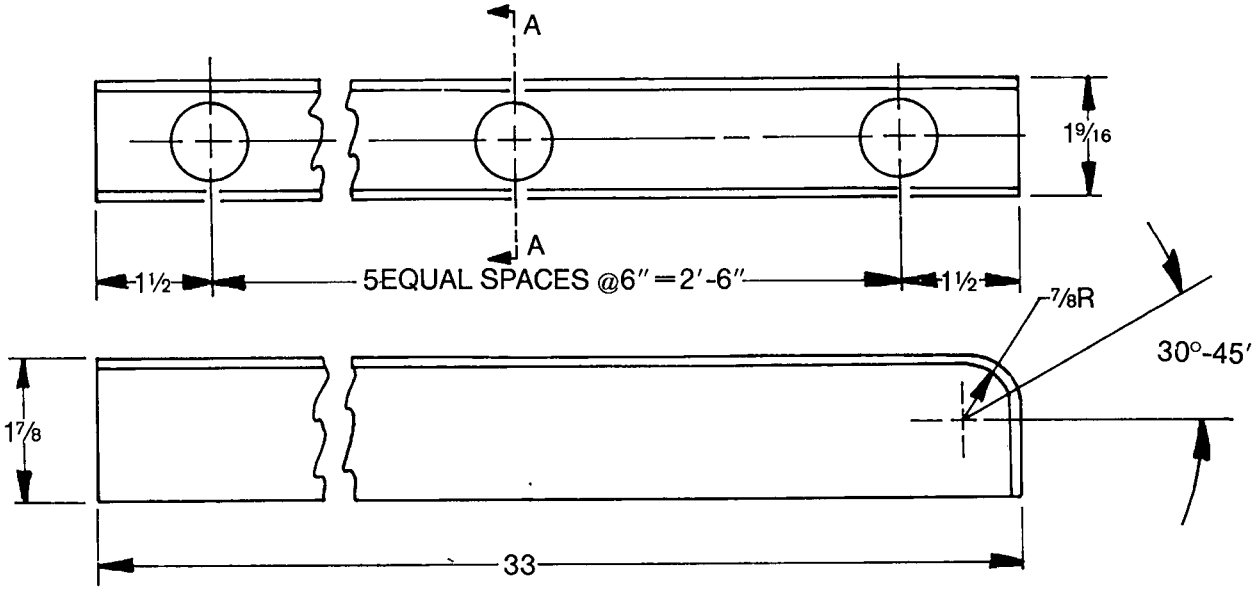


MOLD NO. 4822



TYPICAL CROSS SECTION
FOR MOLDS 4822 & 4821

SECTION A-A



MOLD NO. 4821

JOURNAL DE LECTURES